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INSTITUUT VOOR PHYTOPATHOLOGIE.
LABORATORY FOR MYCOLOGY AND POTATO RESEARCH.

A STUDY INTO THE LITERATURE ON STIPPLE-STREAK AND RELATED DISEASES OF POTATO

BY

D. ATANASOFF.

> Is there any thing whereof it may be said, See this is new? it hath been already of old time, which was before us.
>
> ECCLES. 1 : 10.

INTRODUCTION.

Looking through the literature on potato diseases in order to see whether the disease recently described as a new disease under the name „Streak" has been known before, the writer came to the unexpected conclusion that this „new" potato disease is in reality one of the oldest if not the oldest known disease of this plant. It became further evident that some of our present conceptions regarding the relation of leaf roll and mosaic disease to the „curl", „Kräuselkrankheit" and „frisolée" of olden days are quite unfounded, and that as far as the nature of these diseases, also called „degeneration" or „running out" diseases, is concerned, many efforts, much of the useless searching in the darkness, which is still being continued in some countries, and much of ink and money could have been saved if we had only known the older literature on this subject.

The object of this paper is to bring together in concised form the literature on this group of diseases.

The entire literature on the running-out diseases from 1775 until 1900, so far as it has been possible to locate it, is treated here. From 1900 until now only the works dealing with streak

or better stipple-streak [1]), which also belongs to the above group of diseases, are being included in this paper. This was done first because the rest of the literature on „running out" diseases since 1900 is fairly well known and easily accessible, and is so extensive, that it would have materially increased the size of this paper; besides with the exception of the works of only a few authors, it is so valueless that it does not merit any consideration.

The literature on „running out" and „degeneration" of potato from agricultural stand point has been also left out. Only few of the most important works which give at the same time extensive bibliographies are included in the list of literature cited, for the sake of those who may try to go again over the literature on degeneration of potato.

A working over of the literature, here under consideration, would take away much of the „individuality" of the various works and besides it would hardly be possible in this case. For this reason every work is treated here separately and in chronologic order.

In a large number of cases, especially in the English works, the authors while discussing the cause, nature, and remedies against curl, kroesziekte or Kräuselkrankheit do not describe the disease which they discuss or their descriptions are such that no potato disease can be identified with any degree of certainty with these descriptions. Practically in all cases where the descriptions make possible the recognition of the disease the latter is usually the disease known at present under the name of „streak" or streak plus crinkle or mosaic. With exception perhaps of Schacht's description of Kräuselkrankheit there is no reason whatever to suppose that the older writers on curl, Kräuselkrankheit or frisolée have been using these names for designating the leaf-roll disease of potato. The first reliable description of leaf-roll is the one of Appel in 1906, while the first reliable descriptions of streak under the name of curl, Kräuselkrankheit, and frisolée are over one century older.

The writer is greatly obliged to the staff of the libraries of the Landwirtschaftliche Hoch Schule Berlin, the Biologischen Reichsanstalt für Land-und Forstwirtschaft, Berlin-Dahlem, the Landbouwhoogeschool te Wageningen, to Mr. Cotton of the Kew botanic Gardens and to Mrs. N. L. Alcock of the Patho-

1) For reasons which can not be discussed here and which are given in writers first paper on this subject, preference is given here to the name „stippie-streak" in designating the disease known now under the name „streak".

logical Laboratory Harpenden, England, for their valuable help in gathering the literature and to Prof. Quanjer for reading and criticising the manuscript.

FIRST PERIOD. 1775—1900.

About 1775 there appeared in England and on the continent of Europe a peculiar disease on the potato plant, which expressed itself in a stunted and dwarfish growth of the plants, curling and spotting of their leaves and stems and a marked and sudden decrease in the yields, so that in many localities the farmers had to give up the cultivation of this plant or the then favored varieties of same. The plants attacked by this disease bore so distinctly the stamp of „degeneration" that from the very first recorded appearance of the disease until the present moment the idea of „degeneration" „running out", „ontaarding", „Ausartung", „Abbau", and „senility" has been the dominating thing both in describing and explaining the nature and cause of the disease.

During the following few years after 1775 the disease appeared almost in an epidemic form and gained in destructiveness, so that it soon became the subject of the day in all countries concerned: the practical man, the man of learning and the governments were deeply concerned in the sudden appearance of so destructive a disease, which threatened the culture of the potato plant. Learned societies and governments, local and national, did offer numerous prices and encouragement to those who would discover the cause of and remedy for the destructive disease of so useful a plant, which people in those days considered as God's great blessing and their only assurance against the then not uncommon hunger years.

Indeed in some localities special measures were taken for preventing the introduction and spreading of the disease. From this period and up to the present day this disease has never left the potato plant and we find it more or less common wherever potatoes are grown on a larger scale.

In 1779 an anonymous writer described this disease in Germany as follows: „As soon as the plants show above ground, they become curled, remain stunted, part of them disappear entirely, others remain growing but never blossom, or produce only few blossoms, which fall off soon after and never form berries. They set no or only very small tubers, which are as hard as stones and unfit for eating. When planted they give rise to plants that are not always attacked by the disease. This trouble appeared first only on the white Speisekartoffeln; the Red and

large English Mastkartoffeln were free from it. In the year 1779 practically all white potatoes were destroyed, the Red-and the English potatoes were also severely attacked, while the Suppen or the so called Zuckerkartoffeln remained free from it".

Upon pulling out one of the infected plants the writer saw a distinct wound at the base of the stem next to the seed tuber, this he took for insect injury and expressed the opinion that the cause of the disease must be some insect.

As an answer to the above there appeared shortly after in same periodical a second anonymous article in which was expressed the opinion that this trouble is nothing else but a degeneration of the potato-plant, resulting from the continuous asexual propagation of same. As a control measure he recommended the renewing of the varieties from seed.

This opinion, which was expressed almost simultaneously also in Egnland and in other parts of Europe, has persisted more or less until the present date, in spite of the fact, that it was shown very early that plants produced from seed are as much subject to the disease as plants produced from tubers.

Müller in 1780 read a paper on the degeneration of potato at the meeting of the Kurfürstlichen Ökonomischen Gesellschaft at Lautern. This paper we have unfortunately in abstract form and it seems that the abstracter has missed some of the important points. Here follows his description of the diseased or degenerated plants: „In spring at the coming out of the potato plants and during the first period of growth the potatoes promise a rich crop, but as soon as the plants reach their full development and just before blossoming some of the vines wilt suddenly, the foliage grows poorly, etc., some plants send out flowers but prematurely. At this time the seed tubers are full of fibers and sprouts, and are unusually watery and their interior rotten, most of these seed tubers rot completely soon after. Such plants give later in autumn few and much smaller tubers. Such tubers are easily recognized by their light and smooth skin, while the healthy tubers have a rough and brownish red skin." Müller is of the opinion that the continuous asexual reproduction, unripe and too large seed-tubers, are the cause of the disease and recommends renewing of the varieties. Only small and ripe tubers, also tubers from uninfected regions should be used for seed. He states that around Donnersberg the potato does not degenerate and that seed from there gives good crops for some years, then it also degenerates, so that the seed should be renewed every few years.

Spring in 1781 advanced the idea that the degeneration of the potato is the result of crosspollination of the common potato by the Viehkartoffel, a less desirable potato variety used only as animal food.

Van Bavegem showed in 1782 conclusively that the degeneration of the potato which results into dwarf and curled plants is not, as was thought by some, due to insect (worm) injuries and that it lies in the tuber itself, and is the result of the fact that the European climate differs from the climate of America, where this plant is native. As control-measure he recommends therefore, the production of new varieties from American seed. His description of the disease is so short that it is not certain what disease he actually had under eye.

Simon published in 1782 what may be considered as one of the best works on the degeneration of potatoes written before the end of the eighteenth century. He describes the disease in detail as follows:

„From externally healthy tubers there grow out in infected regions on all kinds of soil and in all years more or fewer plants, whose appearance is such that even the most unexperienced person sees that there is something wrong with them. The stems of such plants differ from the other well known varieties in that they have an indistinct brown color or rather a mixed brownish green colour. Such stems which represent the first degeneration are always unbranched and in general the whole plant is from the very time of appearing above the ground smaller and remains behind the others in development.

The leaves are not smooth on the upper side as those of the healthy plants, but they are rough, curled, sickly, irregular and shrunken. They do not stand away from the stem and on well proportionate petioles, but stand close to the stem. The color of same is not brownish or darkgreen, as the leaves of the well known potato varieties, but a peculiar mixture of those colours, so that there are brownish green, light and yellowish green spots." Speaking of the general abnormality of the stems he says: „One finds often that the pith in them is also rusty and dried up, and this even in the young sprouts. As result of this there appear the small, and miserable plants, which become yellow early in fall and die at a time when the most rapid tuber formation takes place. It is no wonder then that the tubers of such plants are few in number and remain small, often only two, never more than three on one vine and are unwholesome for consumption. Even the color of the skin of such tubers is

different; it is partly brown, partly light yellow on one and the same tuber, and often the two colors run uniformly into one another."

He distinguishes three groups of this disease: „The first group consists of plants which resemble the plants described above and represents the first degree of degeneration (He means the highest degree of degeneration). This group of plants never comes to flowering. The cause of this lies in the very much destroyed organisation of the plant, which makes it impossible for such plants, which die early to come to flowering.

The second group consists of plants coming from tubers of the first group and is the second generation of this degeneration. This group consists of stronger and more yielding plants. Instead of the unbranched stems of the first group they have stems with some secondary branches. Color and form of the leaves is same, yet some of them may have a healthier color..... A small portion of these plants may flower. Most of the degenerated plants belong to this group" In reality the first group of plants should come from tubers of plants of the second group and not as Simon thinks.

„The third group consists of still less degenerated plants which resemble closely the normal ones. They differ from the last in that their leaves are smaller, curled and stand closer on the stem. The stem is not wholly brown," (i.e. it is striped.)

According to Simon the first cases of degeneration in potatoes in Germany were noticed at the time (1770) when the so called Viehkartoffeln were introducced. Before that time, he states, the disease has never been seen. The more common the growing of this variety became, the more common became also the disease among all other varieties, with the difference only that in some varieties the disease appeared more and spread more rapidly, in others less so. Localities where this variety was not grown remained free from the disease for a long time after, until at last with the general introduction of this variety the whole country did get infected.

The cause of the disease he attributes to the cross pollination of the ordinary potato varieties by the Viehkartoffel. Here is the key for understanding Simon's work. The Viehkartoffel and the other then commonly grown variety had a different color, one was light green, the other brownish green. The diseassed plants which are striped and spotted with brown spots or, according to Simon, represent a mixture of the two colors, he took for hybrids.

Through numerous observations Simon came to the conclusion that wherever the Viehkartoffel was planted in the neighbourhood of other varieties the latter degenerated.

The Viehkartoffel which has been introduced on the continent of Europe in 1770 is called also: Amercan, Wild, New Engländer, etc. It is characterized by a more robust and coarser appearance.

That Simon probably had to deal with stipple-streak is shown by the fact that the diseased plants were stunted, dwarf, stems unbranched with rusty pith, curled leaves and short petioles, brown and green colored; by the early dying of some plants, and the partial browning of the tubers.

Arthur Young in 1784 reports that some potato varieties are curled, others are not, but does not discuss the disease.

In 1783 there appeared on the potato plants in Vogtland (Germany) a disease which decreased their yield to one third and even to one sixth of the normal yield. Ackermann writes of this disease in 1784 that: „The summer of 1783 was in Vogtland so hot that most days there was visible in the air a thick fog. All crops suffered from the drought but the potatoes suffered most. Most of the tubers were hollow, weak, spoiled and unwholesome. Many of the eyes of such potatoes were black and when the tubers were boiled they could be taken out in form of a half pea. The healthy tubers had a changed appearance, their surface was not smooth as usually, but rough and ruptured, when boiled they were not starchy but soft and watery and therefore difficult for digestion."

At the same time he observed an other disease which has been seen in single cases for ten or twelve years before, but this year it was especially severe: „As soon as the plants appeared above the ground they were very much different from the other plants. They had a lighter color, were dry, weak, the leaves much farther from each other on the stem, the leaflets much closer on the petioles. Though the plants continued to grow, yet slower, they did blossom, yet much less, and seldom formed fruit. The small, hard, scabbed and internally hollow tubers had a poor taste." He attributes this trouble due to a red headed larve with hard shell, which according to Appel (1907) may have been the larve of *Eumerus lunulatus*.

When we exclude the hollowness of the tubers, which is not this of the large tubers but of small tubers and consisting of holes and gangways made by the above larve, which is much more common in dry than in wet years, we cannot but

recognize in the two diseases described by Ackermann the stipple-streak disease of the potato plant as seen on the vines and tubers.

In 1788 came out the first edition of Anderson's [1]) essay on „the disease called the curl of potatoes". This essay, which according to Anderson was written in 1778, is a remarkable document. In a concised form and most exact and critical language, supported by sound arguments Anderson tells us in only few pages what he knew and thought of the cause and nature of the curl disease of potatoes and what Anderson thought and knew regarding this disease, as will be seen from his paper, cited here in extenso, does not differ materially, from what now is known and thought of this and related diseases of potato.

Anderson's essay written in 1778, consequently being the oldest paper on this subject, is the most complete and most valuable work ever written on this disease, excepting perhaps very few of the most recent works on same subject. It can safely be considered as an up to date summary of the entire literature on running out diseases of potato. This compact and businesslike paper gives also ample evidence that its author must have been a thoroughly scientific minded person and a most keen observer. [2])

Here follows Anderson's work, the italics are mine:

„Potatoes are subjected to one particular disease, the curl, which it would be improper for me altogether to omit, and though I may say little positive as to the cause of this disorder, a good deal may be said on the negative side of the question; which, as it may possibly lead to future researtches shall here be added.

The only thing that seems to be positively certain with regard to this disorder, is, that it was scarcely, if at all, known till very lately, and in particular that it was not known in the northern parts of this island till a very few years ago (I myself had never seen it when the former parts of this treatise were written) when, there is great reason to believe, it was introduced by means of seed potatoes, imported from the South country, and *it is at this moment much less frequent in the Northern and remote parts, than in the Southern and more commercial districts of this island.*

1) James Anderson L. L. D., F. R. S., F. S. A., of Cotfield near Leith.

2) The letter with which Anderson sent his paper to the Bath Society, dated Nov. 28, 1786, in which he emphasized the importance of research work in agriculture and which was published as an introduction to his paper, will interest every scientific worker.

From this single fact, several corollaries are deducible, which entirely overturn some theories that have been formed to account for this disease. It has been supposed that nature, fated as it were by having long produced this plant in a climate that was not deemed congenial to it, had become so far exhausted as to occasion this disease. *But if so, the more Northern parts of this island, where the climate is the most unfavourable, should have been soonest affected by it.* It has been further supposed, that potatoes that are frost-bitten (the bulbs are here meant) before they are properly housed, occasion this disease in the plants produced from them; but *the curl is least known in those districts were the potatoes are most liable to this accident.* It has been said, that potatoes which are taken up before they attained perfect maturity, infallibly became affected with this disease; but *in some cold mossy soils, and exposed situations, where the potatoes must often be taken up while they are yet in a state of vigorous vegetation, this disease is scarcely known.* It will not be imagined I mean to insinuate that such situations would preserve from the disease, when once introduced in other places around, for that, without doubt, is not the case.

It has been further alledged that such plants as have been lately obtained from seeds, properly so called, are entirely free from the curl. But I have a very striking proof before my eyes at this moment, that this is not the case. *A large field which was planted with potatoes the third year from the seed, has more than one half the plants curled; while another field near it, raised from potatoes that never were, that we know of, produced from seeds in the country has scarcely one curled plant in the whole.*

It is by some alledged that the soil or season occasion the disease, but *that this is not the case is also plain from the state of a field now in my neighbourhood. Several ridges in it, that were planted with potatoes obtained from one particular person, are very much curled, while the remainder of the field, which was planted with potatoes of the same sort, obtained from a different person, is not at all infested with that disease. In this case the soil and climate were the same (for the ridges were intermixed with the others) but the crop extremely different.*

In the last example it is plain, that *the disease depends entirely on the nature of the seed; and it seems to me highly probable that the curl in potatoes, like some hereditary diseases among animals, if once introduced, vitiates the prolific stamina, so as to be perpetuated as long as the infected breed continues to produce others.* But this is hazarded merely as a conjecture. Are there any facts sufficiently authenticated, which prove that a plant once known to

be infected with this disease, invariably produces diseased plants? Or is it for certain known, that in any case a curled potato has been produced from a plant that was perfectly sound, and not in the smallest degree affected with that disorder? Clear proofs by experiments made with the utmost caution are here wanted, and not the result of random observation.

In considering these questions, and comparing them with phenomena already known, it seems difficult to decide which way the probability lies. On the one hand, seeing this disease is, or at least most certainly was, entirely unknown in many large districts where potatoes have been long cultivated, *it would seem to favour the opinion that it only originated from infected seed*: — *on the other hand, it is asserted as a well-known fact, that fields which have been planted with seed that was in the former year very little if at all affected, have been known to produce plants the succeeding year, almost entirely of the curled sort.* Should this fact be proved, it would seem to favour the opposite hypothesis, but even here, we shall soon see reason to judge cautiously.

Infectious diseases in the animal creation may be communicated in two ways. One class of disorders can be communicated only by descent from parent to child, and can never be communicated by juxtaposition; another class of diseases can be communicated merely by juxtaposition, and not at all by descent of blood. Does such a distinction as this prevail among vegetables? Has any experiment been recorded, which proves that any particular disease among plants can be conveyed by juxtaposition only? Is not the smut in wheat of this class? May it not extend to others? May not a few infected potatoes in this way, if mixed in a large heap, like a subtile leavening principle, infect the whole? Experiments are here much wanted.

But I am far from alledging that, though it were an established fact that potatoes had been known to be much more infected with the curl, than those from whence the seed was obtained had been in the former year, it would either prove that the disease might originate from other causes than contaminated seed, or make it certain that besides direct descent the disorder could be communicated merely by juxtaposition. For though it should so happen, that the disorder could be communicated only by direct descent, the fact abovementioned might possibly happen in this way. It is well known that potatoes affected with the curl, seldom produce bulbs of a size nearly equal to those of the same kind that are sound. This being the case, should one man, from among the heap of those potatoes which were only in a small proportion affected with the curl, select

only the small potatoes for seed, and otherwise dispose of the larger ones, it is obvious he must thus preserve almost the whole of the curled sort for seed, and very few of the sound; and the potatoes raised from this seed must of course be much more infected with the curl, than the parent potatoes were, from which the seeds were obtained.

On the other hand, should another man pick out from the same parent stock only the very largest bulbs he could find, he would probably have scarcely one curled plant in the whole field. Thus might the seed from the same heap prove to be, in one field entirely free from the infection, and in the other altogether diseased. Men are in general so careless in observing facts of the nature here alluded to, that we frequently meet with inexplicable phenomena like what we have here supposed. But till these particulars be fully investigated, *it would seem to be, from many considerations, the safest plan to select only the largest bulbs for plants, for as there is reason to think the disease proceeds in all cases from the seeds planted, and as the infection must certainly be less virulent in the plants that have been least previously infected with it than others, and as no large potatoes are produced by plants which are strongly affected by this disease, these ought surely to be chosen for plants in preference to others. This I know, that I never yet have observed a curled potato among those I have obtained from large potatoes planted whole.*

Should it be found that this disorder, like the small-pox or measles among mankind, can be communicated by juxtaposition only, in that case it would be prudent to select the large bulbs at the time of taking them out of the ground, putting them all in one heap then, without ever letting them touch the small, and thus keep them entirely separate. *By these cautions, accompanied with roguing the potatoes as soon as they are fairly above ground, (that is, pulling out all those that shewed the smallest symptom of this disease) it seems to me probable it might be in a great measure, if not entirely, avoided.*"

„The greater part of the essay was written in the year 1778, a few observations having been added, which are distinguished from the original essay by being included within crochets (thus)."

Marchall in 1788 attributed the cause of the disease he called „curled tops" due to „too long a continuance of declining varieties" and states that „fresh varieties raised from seed, are not liable to that disease". He writes further that „Plants procured from the Morelands remain free from it in the Vale, the first year: but being continued, become liable to the disease."

„The disease of curled tops is seldom obvious at the first coming up of the plants: but attacks them as they increase in size; the entire top becoming dwarfed and shriveled as if affected by drought, or loaded with insects; they nevertheless live, and increase, though slowly, in size, but the roots are unproductive".

„Where the attack had been partial, weeding out the diseased plants as they failed, is said to have had a good effect. And it is said, the Morelanders got rid of the disease through this means".

Mordaunt in 1790 speaking of „curl" states that „the leaves curling to a very great degree; when that happens you find only one or two small roots not worth the expense of taking up". As cause of the disease he considered a milliped, which bored into the potato stems.

In 1790 there appeared in England simultanieously three papers on „curled potato" which were presented to the Society of Encouragement of Arts, Manufactures and Commerce for the prize offered for the best paper on this subject.

William Hollins the author of the first paper writes that: „The curl in potatoes is a disease which admits of three different stages or degrees:

1st. The half curl,
2d. The curl.
3e. The corrupted.

1st. The half curled plants have leaves somewhat long and curled only in a moderate degree. They produce a tolerable crop if the summer be not very dry; but if otherwise the potato will be small and watery.

2d. The completely curled plants are seldom more than 6 or 7 inches high, they soon ripen and die. The potatoes are generally smaller than a nutmeg, of a rusty red colour and unwholesome as food.

3d. The corrupted potatoes or those in which the vegetative power is nearly destroyed never appear above ground. The seed may be found at Michaelmas as fresh to appearance as when it was set with a few small potatoes close to it".

The cause of curl he attributes to the manner in which the seed has been raised the preceeding year: too rich soil, earthing and manuring of the fields: „By earthing and manuring you will only raise large crops of large potatoes perfectly good as food but imperfect as seed".

William Pitt, the second author, recommends on the other hand the breeding of new varieties and advises the potato grower „to secure his seed from as perfect a plant as possible and by no means to use seed of a worn and degenerated plant."

John Holt, the author of the third paper, contrary to the first two writes the following on curl: „The cause of this disease, as far as I can judge does not arise from peculiarity of soil, variety of manure, difference of season, dry or moist, the cause, therefore, whatever it may be it should seem originated from the seed which when once infected I imagine is incurable and the disease or curl appears to be nothing more than a total degeneracy of the plant by being worn out by want of change of seed upon the same soil with probably some other causes cooperating". In his second article on same subject he states that fresh seed from the moor lands gives as good results as potato seed brought from Scotland.

John Billingsley writing in 1792 on the culture of potatoes is not sure of the cause of curl of which he says: „It seems enveloped in an impenetrable mystery". Potatoes brought from Dumfries were never curled the first year. „Perhaps the second year a few would be curled, but beware of the third, for be it assured, let your soil or manure be ever so good, almost all will be curled the third year, if planted in the same soil and neighbourhood".

Parmantier, whose activities in connection with the introduction and spreading of the potato plant in France are well known, speaking of the diseases of potato in 1793 says: „But the disease which especially attacks the potato, known in the district of Lyon under the name frisolée and in Flandren under that of pivre, is characterized by the mottled brownish green stems, wrinkled, weak, curled and standing close on the stem with yellowish spots and of a peculiar texture leaves".

Buchan-Hepburn writes in 1794 that the curl disease of the potato, which he does not describe, has not been observed in the East Lothian county until about 1778. In 1780 it was very destructive in Lancashire, „but it was not till 1784, that it was feriously (furiously) felt in this country, when it seemed to threaten the total extermination of the plant. The only remedy is change of seed. It is somewhat singular, however, that this distemper is unknown in the higher districts of this country, at an altitude of about 400 feet above the level of the sea". „The seed brought from that district, may be planted for two

years; but if continued longer, the curl takes place, and the 3d., and every subsequent year, it grows worse and worse." Same fact was observed also by Tuke and Holt.

Buchan-Hepburn thinks that the reason for this lies in the fact that in the higher and northern regions the potatoes never ripen fully and are usually harvested, on account of the early frost, while still not fully ripened. He comes then to the conclusion that the potatoes for seed, where curl is present, should be harvested earlier than the rest of the potatoes in order to avoid the disease.

„The renewing of the seed by raising it from the apple, has been repeatedly tried in this county, and it has always proved ultimately unsuccessful; that is this new seed in the course of a few years became curled".

He reports also that the „Yam" or „Surinam potato" which is a very prolific and unusually late variety has never hitherto been injured by the curl. This variety which is a less desirable one and was commonly used as animal food is stated to have been brought by a sailor from America (Löbe) and has been known in England ever since 1711. Same variety was introduced into Germany under the name of „Viehkartoffel" in 1770 at the time of the great food scarcity and has been considered as the cause of the Kräuselkrankheit in Germany.

Kirkpatrick in 1796 while not describing the disease recommends as control measure against curl the annual change of seed. He tells us also how it came about to discover that seed potatoes brought from Scotland to England, where the curl was causing at that time great damage, gave the first year curl free plants. About 1776 at a time when potatoes bore a high price in England, a sloop load arrived from Scotland at Liverpool late in the spring. These potatoes were used for planting and gave such good and free from the curl crops, that many sloop loads have been annually imported since that time for planting: A practice which has persisted for over one hundred and fifty years and which is being used now on a large scale.

An anonymous writer in 1798 saw the cause of curl in the growing of potatoes from the seed of the potato berries. He recommends as control measure the destruction in the field of all curled plants as soon as they appear above the ground or as he writes: „when they are about three inches high". He states also that no curl has been seen on the Red potatoes, which he attributes to the fact that this variety is never grown from the seed. He personally planted the seed of this potato and got

some curled plants. May not this be an indication that resistant varieties can be obtained through breeding. This author states also that no curl has been known up to about 1750 and that it appeared first about ten years later when the breeding of new potato varieties from the potato berries was introduced.

Stockmar in 1801 not only did make observations in connection with the degeneration or Kräuselkrankheit of potatoes but actually tried to establish in an experimental way the cause and nature of this malady. Speaking of the marked decrease in yields due to it, he says: „At the same time one notices that a large portion of the plants does not have any more the healthy appearance as before, that a large number of them are not only unnaturally curled and withered as if the mildew has attacked them, but that their stems are single and unbranched, while the healthy plants have many secondary branches. These not only sickly looking but actually sick plants when pulled out are easily recognized by the rust like spots, which often reach as far as the pith of the stem, such plants seldom remain alive until harvesting, but usually wilt and die already in August .... of which later not even a trace is to be seen." He also reports that wherever the Viehkartoffel is planted next to Red potato (the commonly grown variety of those days) the latter is usually more attacked; in such cases the disease not only does spread more rapidly, but it becomes so common that the farmers did consider it as a punishment of God. The Viehkartoffel it self, he states, as was noticed also by Simon and Ackermann, does not suffer from the disease and even though much poorer in quality it did gradually replace in most localities the ordinary varieties, both red and yellow, which did suffer much from the disease.

The cause of the disease he sees also in the cross pollination of the common varieties by the Viehkartoffel: The diseased plants are nothing but hybrids of the first and second variety, including the tubers. He also makes the statement that in localities where no Viehkartoffel is grown there is also no disease.

Stockmar made at last some experiments to establish the correctness of the above hypothesis. For this purpose he took tubers from the susceptible potato varieties from localities where the disease was not known, one portion of these tubers he planted away from, the other portion next to Viehkartoffeln. The first year all plants remained healthy. The second year he planted the tubers of the potatoes that have been next to Viehkartoffeln away from such potatoes and planted again other

healthy potatoes near the Viehkartoffeln. Of the potatoes which the first year have been next to the Viehkartoffeln he writes: „After the first leaves had hardly appeared above the ground I saw what I had suspected: more than half of these plants were curled, while the potatoes grown the previous year away from Viehkartoffeln, also those which this year are next to the latter did not show even the slightest symptoms of curling." The curled plants he considered, therefore, as „hybrids": the red potatoes being pollinated by the Viehkartoffeln. There can be, however, no question of hybrids, as Stockmar used not the berries but the tubers of the „crosspollinated" plants.

He made another experiment: Some plants standing next to Viehkartoffel plants he marked and removed their flower buds before flowering, others of these plants he let flower. The following year all of the first gave healthy plants most of the second gave diseased plants. This he took as a second confimation of his hypothesis. Seeds from the berries of plants standing next to Viehkartoffeln and which he considered as infected produced healthy plants the first and the second year, while the tubers of same plants gave diseased plants. He concludes then that the seed itself is not affected by the crosspollination and that only the tubers are affected. As control measures he recommends: 1. Growing separately the two kinds of potatoes. 2. Using seed for raising of new plants, which also get infected if planted next to Viehkartoffeln. 3. Only tubers from healthy plants should be used for seed. 4. Using seed from uninfected regions.

Thaer (1801) observed in 1790 in West Germany the disease then called „curl" in England. Of it he writes: „When the potato plants reach their full development and just before flowering they become suddenly curled, wilt and dry up. The yield is then very small. The real cause of this disease has not been found yet. It is certain however that the cause does not lie in the soil, in the cultural methods or in the climate, but in the seedtuber itself. As soon as this „curl" appears on some plants there must be brought seed from somewhere else, otherwise the following year it will become much worse. It is highly probable that some insect which is too small to be seen and which lays its eggs in the tuber is the cause of this disease. It has been thought that the disease can be controlled by growing potatoes from seed, but the seedlings are attacked even more. Large and healthy tubers from localities where the disease is not known did always remain healthy. For that reason many people order

such tubers every year." In the 3d. volume of his classical work which appeared three years later, speaking again of curl he applies to it the name Kräuselkrankheit. Here he states also that the white varieties are less attacked by the curl.

An anonymous writer in the Farmers Magazine of 1802 recommended the use of the „little" or aerial potato tubers for seed as control against curl.

Höse in 1804 writes that roguing of all infected plants did help in controlling the Kräuselkrankheit.

Pryce in 1802 agreeing with Billingsley that the cause of the curl disease of potato is „involved in impenetrable mystery" writes of it that „Like him, I have found that potatoes of same sort, kept in the same manner, planted at the same time, in the same soil, and in every respect alike circumstanced, have produced part of the crop curled, and part not curled; — and like him I have found two shoots from the same set, of which the one was curled, and the other healthy".

„After much diligent observations and enquiry, I had reason to believe that the disorder did not arrise from degenerated or defective seed; and as it is certain that the plant is diseased when it first appears above the ground, I concluded that the germ or shoot must receive an accidental injury, between the old set and the surface of the ground". This injury and therefore the cause of the disease he atributes to insects.

„In northern aspects, or on cold damp land, the curl is less frequent than on warm or sandy land, where insects are more numerous: and it is pretty generally acknowledged that seed potatoes, procured from damp morassy lands, or those from more cold or northerly climates, or situations, will not curl the first year after planting".

„The potato, it is said, was introduced into this Island near two hundred years before the curl made its appearance. That this vegetable should, after such a period, suddenly degenerate, and that the soundest seed should now degenerate in two or three years, seems not very consistent with sound philosophy".

„It may be remembered that about fifteen years ago, when the curl was most fatal, there was a general alarm for the consequences that might arrive from insects. Almost every bush teemed with their nests". This fact is here recorded as in the light of recent investigations it seems quite evident that there exists a close relation between the severity of the running out diseases of potato and the amount of insects in the different years.

In 1802 a correspondent of the Farmers Magazine attributed the cause of curl also to various insects and even to „minute animalculae", which attack the underground and aerial portions of the potato plant. „I think, he writes, I have also observed, that these insects prefer one potato to another. They will hardly touch a Yam (an undesirable potato variety)". There is considerable truth in the last statement and taken theoretitally it will be possible to breed insect-resistant potato varieties, just as has been done with other plants. Should this actually be possible and if it is true, as is generally thought now, that the degeneration diseases of potato, at least most of them are transmitted only by aphids, then the breeding of aphid-resistent potato varieties will be also an effective control measure against this group of diseases.

Dickson, R. W. in 1805 discussing the curl disease of potato, without describing it, states that „most of early authors considered it in general as originating from distempered seed, which caused it to appear in the crops wherever it was made use of". Reviewing the then prevailing suppositions as to the nature and cause of the disease he seems to be inclined to think that insects attacking the seed tuber may be the cause of the disease," as it was found that, from a potato planted in a field as seed, there proceeded four stems, two of which were weak and delicate, having their leaves attacked with the disease, while the other two were in a highly vigorous state, and their leaves fresh and free from the curl. On the root being taken up, it was discovered that all the part from which the curlleaved stems proceeded was excavated, the substance being wholly consumed by insects." It is more than evident that partial injury of the seed tuber, especially after it has germinated can not be the cause of the above conditions. He adds further: „Sometimes it is, indeed, supposed, that the disease may be caused by the leaves only becoming the pray of numerous minute animalculae, but that the general cause is in the seed (the tuber) itself being consumed" (by insects). This suggestion that the curl disease is caused by a bacterium in view of the fact that at that time nothing was known of the pathogenicity of bacteria cannot be taken too seriously and is here recorded only for the sake of completeness.

An other opinion concerning the cause of curl was that it lies in the season and that „where the spring is late, cold, and frosty and the potatoes set at an early period, the crop is mostly injured by the curl; while those that are planted at a

later period, and which are not so much exposed to the effect of cold and frost in their early growth, are more free from the disease." This agrees with the conditions under which the epidemic appearance of stipple-streak in 1921 took place among the early potato varieties in North Holland. Only further observations, however, can show whether this really stands in some relation to the disease. Whether the disease Dickson discusses here was really stipple-streak or some other of the diseases related to it is not at all certain from his discussion of curl.

Stating that „though many of the different causes may operate in producing a tendency to the production of curl in potato crops, they do not any of them seem fully sufficient to account for the disease in a perfectly satisfactory manner", and that „further investigations into the nature of the disease is still wanting in order to fully elucidate its cause", he adds: „That something of this nature takes place, seems evident from the circumstance of only some of the plants being diseased, while others nearly adjoining them are in a healthy and luxuriant condition".

Dickson remarks also that „the general experience of cultivators has fully shown that the crops of such potato sets as have been brought from high cold climates (Scotland and North England) where the potato scarcely ever arrives at that state of perfect maturity in which seed is produced, is rarely if ever affected with the curl for the first year".

Howdeniensis in 1805 attributed the cause of curl due to the „difference in temperature" in the pits and in the field.

Baron Hepburn [1]) in 1808 assures us also that up to 1778-1779 the curl disease of the potato plant has been unknown in Scotland or that it has been present in a very small amount, „too trifling to merit attention". The first case of curl as a serious and alarming calamity was observed in the autumn of 1780, „it so infected the crop of potatoes in Cumberland as to threaten total exclusion of the potato from the husbrandry culture of that country". In the year 1783-84 the curl made again a general and alarming appearance in the low part of Scotland. Contrary to former writers he states that potato produced from seed remain free from curl during the first few years. He repeats again his former observations that curl is common in the low part of Lanarkshire and Renfrewshire, but it has been never seen in

1) Formerly Buchan-Hepburn, G.

the parish of Strathaven (Lanarkshire), in the mountains of Lammermoor, nor generally at an elevation of 400 ft. above the level of the sea. Seed brought from these regions down to the coast might be safely trusted for two years.

Thomas Dickson in 1810 discussing the curl of potatoes writes that of all the different theories regarding the cause of curl the one of Baron Hepburn (1794) that the curl is the result of an overripening of the tubers, is the right one. As control measure he recommends later planting, earlier harvesting, and preventing the plants from flowering.

Shirreff in 1810 taking for granted that all plants do eventually die considers the potato curl therefore, as a state of senility and recommends the raising of new varieties from seed.

Crichton in 1814 after numerous „experiments" comes to the unique conclusion that „wherever the seed stock is carefully pitted and not exposed to the air in the spring, the crop has seldom had any curl, but where the seed stock is put into barns and outhouses for months together, such crops seldom escape turning out in a great measure curled".

Putsch and Bertuch in 1819 described the Kräuselkrankheit as follows: The plants attacked by this disease have an unusually miserable appearance. The stem is unbranched, brownish-green or striped, covered here and three with rust spots, which penetrate as far as the pith, so that the latter is no longer white but rusty and sometimes even black. The leaves are not smooth on the upperside, as those of the other plants, but are rough, wrinkled, curled, weakly and shrunken; do not stand away from and on well proportionate stems, but stand close to same. Their color is not brownish or dark-green, as the leaves of the healthy plants, but have at the same time a peculiar mixture of both of these colors, so that there are on them brownish, light green and yellowish green spots.... Even the skin of the tubers is different. It is partly brown, partly pale yellow on one and the same tuber, and often both colors are intermixed. Experiments have shown that some varieties are more, others less susceptible to this disease; that the potatoes in the mountains are less subject to it than those in the plains, and that the round and long red varieties suffer more from it than the white varieties. The disease passes over with the tubers to the next generation and only after careful cultivation (roguing) it will not disappear before the fourth or fifth generation."

In Schnees landw. Zeitung of 1828 an anonymous writer

repeats the above description of this disease and reviews Hollin's and Dickson's papers on same subject.

Wiegmann in 1839 placed the Kräuselkrankheit of the potato in the group of diseases which he calls „diseases of the respiratory system" and considers it as a „Hautausschlag": „The Kräuselkrankheit of potatoes should not be mixed up with the similarly called disease of the peach tree and apricot, it is the result either of cold nights or poor soil. Cold winds and cold nights following after warm days weaken the potato plant originating, from a warmer climate, which is even less able to resist the above injuries than the first named plants. The leaves are attacked by a black rust, curl and fall off, the tubers robbed of the intimate connection with the leaves, which nourish them, remain behind in their development and have an inferior taste."

Berchthold in 1842 repeating Ackermann's and Putsch und Bertuch's descriptions of the Kräuselkrankheit writes as follows concerning the eye disease of the potato, which he considered as a distinct and different disease: „Plugging of the eyes is the disease which appears on the surface as a black spot, from which cylindrical black bodies, 2—3 lines thick or round, resembling the mass of the potato but somewhat more compact, press towards the heart of the tubers. Some of the destroyed and blackened eyes can be taken out in form of a black pea". He also states that the round and long red varieties are more susceptible to the Kräuselkrankheit than the white varieties, and that the disease is more severe in the plains than in the higher regions. It is transmitted with the seed tuber and disappears when careful selection is practised after four or five generations. Of the cause of the disease he is not certain, but states that „there appear practically no diseased plants when tubers from diseased plants are laid in holes in which have been placed some wood ashes and salt and over them are spread some wood sawings". At the end he mentions the old hypothesis that the disease is nothing but degeneration of the plants due to senility.

Martius and Löbe in 1842 and Münter in 1846 describing the then epidemic appearance of the Phytophthora disease gave also an up to date review of the literature on potato disease, including the Kräuselkrankheit.

Thompson (1845?) planting potatoes on a very rich soil and the season being unusually favorable, he expected a rich crop,

but he was „much disappointed to find that the braird was weakly and soon showed symptons of curl. This increased, and though few of the plants perished, nearly the whole were unhealthy . . . . wherever the disease had made a decided impression on the set, the stalks of the plant were marked with brown streaks and patches, and evidently showed that the juices which they were conducting from the set were vitiated and noxious. The part of the stalk to which I directed mij attention was that underground, in which it was easy to trace the progress of the disease, from their being white and nearly transparent. Wherever the top was curled I found the stalks unsound and the set diseased. In some cases the disease carried the day, and the set reaching an advanced stage of decomposition, and the stalks below ground became quite brown, the top died away. In a subsequent season (1844) most of the sets attacked perished, but on this occasion a very great majority of the plants threw out strong roots, and finding an abundant supply of food, maintained a constant struggle with the disease, and eventually yielded a good half crop. A few green healthy plants stood prominently out amongst the brown half-withered tops of the rest". These plants he found to be of a different variety (Cheshire white). From the above he concludes that the curl, dry-rot and wet-rot are one and the same disease, and that curl represents a mild attack of the disease, which when „violent" destroys the set before it can germinate. The following year he planted again part of the above seed, but somewhat later (8th of June) and obtained a perfectly healthy crop, whereas plants from an other sample of tubers showed much curl and gave a failure crop. This he attributes to the fact that the first seed has been harvested earlier (2d of October). The cause of the disease he sees therefore in the „overripening" of the seed and recommends the use of unripe seed. It is certain from what we now know of this disease that the „unripe" seed or the late planting in this case could not have been the reason of the disappearance of the disease in the following generation. It is very likely that Thompson took by mistake one lot of tubers for the other. This is supported also by the fact that his intention was not at all to experiment with these tubers, but one of his crops having failed he plowed the ground and planted potatoes as second crop on same land, taking evidently as seed what had left over. The curl of the potato plant at that time was too well known in England to suppose that he had to deal with an other disease, which seems highly improbable when we consider his description of the disease.

John Townley in 1847, reviewing practically the whole English literature on curl up to date and the numerous theories and most opposing observations regarding the nature and cause of curl in potatoes, accepts Knight's teaching that „a progessive decline of the vital powers takes place in the potato, corresponding to the familiar phenomenon accompanying old age in the animal world.... the gradual alteration of the tubers is of too general and progressive a character to be the exclusive result of any external influence. It is manifestly a consequence of the declining power of the inherent principle of life.

Mr. Knight's observation that the dry and farinaceous tuber „indicates some degree of approximation to disease" is evidently well founded. The shrivelling of the aged vegetable corresponds exactly with that of the aged animal and obviously arises from similar causes". Stating that unripe tubers from plants harvested early, from late-planted plants, or from plants from northern, cooler and higher locations give curl-free plants, he writes that: „Possibly the ripe state of the tuber of an aged variety may expose the plant to attack by some animal or vegetable parasite. The stems of curled plants have been observed to be „marked with brown streaks or patches" or „rusty coloured spots", but it is not certain whether this is due to decay or to parasitic action. It is highly improbable that aphids are the cause of curl, the fact that healthy and diseased plants grow side by side being irreconcilable with their method of attack".

Gasparin in 1848 describes the potato disease called frisolée in France, which name he also uses, as follows: „The stems are conspicuous by the rusty spots, the edges of the leaves are wrinkled, the later are irregular and curled. The young plants die at a time when their growth should be most vigorous, and form but few small tubers, which have a pungent taste. Some varieties are highly susceptible to the disease. It is thought that it is propagated by planting infected tubers, which are recognized by their hardness (corkiness). This condition has been attributed due to the presence of an insect in the pith of the stem and as control measure has been suggested placing some ashes and salt in the holes in which are to be planted the tubers". This control measure Gasparin has evidently taken from Berchthold.

Stephens in 1849 states that the then well known curl disease of potatoes, which he does not describe, is transmitted with te seed from year to year.

Uilkens in 1852 decsribed briefly the disease of potato which

he calls „Krol" or „Krul" as follows: The fresh color of the leaves disappears, the leaves are shriveled, the growth ceases and the plants remain small and weak the whole summer. This disease is as common as the potato disease was some years ago and does sometimes destroy whole fields. It is especially common on the variety Stoelmatten.

Schacht in 1856 describes the Kräuselkrankheit of potato as follows: „The Kräuselkrankheit appears on the leaves first in form of pink-red or violet-brown colored spots, which appear on the tips and edges of the leaflets and preferably on the top leaflets. It appears first on the upper side, the edge of the leaf curls, its wave-like undulations turn upwards. The curled violet-brown colored portions are at the same time firmer and harder than the surrounding healthy but soft leaf tissues. The Kräuselkrankheit appeared this year in the cases observed by me on the same day when the first symptoms of the potato disease in form of yellow spots became apparent.

The disease starts here as in the case of the late blight from the upper side of the leaves. No fungi whatever are present."

The above description makes it more probable that Schacht had to deal with the leaf roll disease of potato, while his illustration of same reminds us more of potato mosaic.

This single case in the whole literature on degeneration and running-out of potatoes, against which there stands a large number of much more reliable and more extensive papers on this subject, has led in recent years to the conclusion that the name Kräuselkrankheit and curl are „Sammelbegriffe" and that they do not designate a certain disease, but that they cover a number of related diseases, including leaf roll.

It is necessary to learn Schacht's ideas regarding the cause of Kräuselkrankheit in order to appreciate how little value should be attached to his work on this disease: „The cause of the Kräuselkrankheit seems to be the same as that of late blight .... Weather conditions, depressing (schwüle) storm air followed by a sudden dropping of the temperature seems to be here also the first cause of this trouble, the same under certain conditions passes actually into late blight. The portions of the leaves attacked by the Kräuselkrankheit become black and begin to rot, especially in moist and warmer weather, the well known potato fungus (*Peromospora infestans*) then established itself on them; in dry weather they (the leaves) remain for some time fresh and dry up afterwards without rotting and fungous association .... since it (the Kräuselkrankheit) is closely related to the late

blight (the real potato disease) and passes into the latter, it is therefore probable that certain conditions must favor the appearance of this form. This explains also the so common mixing up (?) of the two troubles with one another". The Kräuselkrankheit is nothing but a form of late blight, both of which are caused by a sudden change of temperature!

A more naive treatment of the two diseases, both of which were at that time almost as well understood, fundamentally at least, as now, is hardly possible, and it goes far beyond any of the eighteenth century's conception on this question. The contribution of the well-known botanical authority to the understanding of both of these diseases must therefore be considered as absolutely negative. Such an opinion held by so renowned an authority, at a time when numerous other writers were beginning to consider *Phytophthora infestans* as the real cause of late blight and who knew already that the Kräuselkrankheit is transmitted with the seed tubers, and that it has nothing to do with the disease before-mentioned, must have had a retarding influence upon the studying and understanding of both problems.

Kühn in his classical work on plant diseases describes the Kräuselkrankheit which contrary, as he states, to the Stephens' statement, that it is to be seen even in earliest development of the plants, he observed first in June. „The diseased plants are noticeable by their dwarf appearance from far away. They have not the green color of the healthy plant, the leaflets of the leaf are not only curled and wavy but the main petiole is bent down, so that the whole foliage appears curled and drawn together. The leaflets show local discolorations and at the point of bending of the main petiole there usually appear dirty brown, more or less elongated spots which did appear even on the stem, and became gradually more and more numerous. The discoloration of the cells in these spots while originally only superficial, gradually penetrates deeper, so that in such places the browning eventually penetrates into the stem, so that the pith takes on also a brown and rusty appearance. On the gradually more and more wilting leaves as well as on the brown colored spots of the leaf veins, petioles and stems I could not find any fungous mycelium, nor a fully developed fungus. On the other hand the stems did show, even in places where there were no spots, a peculiar texture, they are brittle and did break, when bent like glass. It seems to me that the cause of this lies in an unusual turgidity („Vollsaftigkeit"). Another cause of the disease was not to be seen. In some rows of plants there were

some perfectly normally developed, while the greater portion of the plants around them showed all symptoms of the disease". Kühn considers it as probable that the weather conditions may have some influence upon the appearance of the disease, but thinks that it cannot be a determining factor, and noticing that the disease appears preferably on very succulent and vigorous plants, he expressed the opinion that anything which may bring about a uniform growth and development of the plants will be a proper control measure against this disease.

In 1872 Kühn describes again the Kräuselkrankheit as before, but it seems that in this case besides stipple-streak be must have had some other disease, as well, probably mosaic, as he states that some of the infected plants at several times during the summer did recover more or less from the disease after coming of dry weather, while with the coming of rain the disease reappeared again. This as we know now is quite typical of potato mosaic. The above thing happened in such a distinct form only in one variety, while in most cases the plants of the other varieties remained sick for the whole season. Here he states that the disease can be very severe and that in some varieties over 50 % of all plants were diseased, and that large number of them died before the middle of August. He saw the disease as bad on seedlings and young varieties as in old varieties and opposes the then prevalent opinion, that the disease can be controlled by growing only young varieties and by breeding potatoes from seed. He opposes further the idea that the appearance of the disease means a degeneration or senility of the potato plant and shows that the variety Lerchenkartoffel described by Putsch and Bertuch in 1819 was then as much valued and gave as good yields as before. Same, he states, is true of the variety Zwiebelkartoffel, also described by Putsch and Bertuch. With numerous data he shows that now potatoes are yielding as much as before. In years when there has been noticed an actual decrease in yield, this has been the result of distinct potato diseases. Unquestionably, he writes, some varieties are less, others more susceptible to these diseases, but this lies in the nature of the variety and not in its age.

Sorauer in 1874 described the Kräuselkrankheit as follows: „The petioles of the infected plants are usually bent down or completely rolled, the leaflets are wrinkled and wavy, with brown, mostly elongated spots. The latter extend along the petiol of the leaf and finally over the stem. At first only the outer cells of the spots are brown, the browning extends later

into the interior tissues and in the stem as far as the pith, while the normal elasticity of the stem may change into a glasslike brittleness .... When such plants remain alive until digging they show no or only a scarce tuber formation." The cause of the disease he sees, as Kühn did, in the too heavy manuring and recommends the use only of well decomposed manure and planting the potatoes on light or well drained land and on high locations.

In 1875 there appeared again in England and on the continent in Europe, especially in Germany, the curl or Kräuselkrankheit of potatoes, which, while seen in the previous few years on single plants, appeared now in a somewhat epidemic form. Both in England and in Germany this caused a great apprehension and excitement. A stream of papers on this question appeared in both countries and there was, at least in the beginning a great misunderstanding as to the nature and cause of the disease.

As an illustration of the above may serve the first paragraph of an editorial warning in the Journal of Horticulture of June 17, 1875. p. 469:

„Warning! New potato disease.

We regret to announce the appearance of a New potato disease more destructive in its effects by far than that (the Phytophthora disease) from which the plant has suffered during the past thirty years".

In an editorial article of the Gardener's Chronicle of July 3d, 1875 this disease, now called the „New potato disease", was described as follows: „Some of the plants are throwing out new roots, and seem in a poor way to recover. In most cases, the formation of tubers is totally arrested, but in other cases, the tubers are formed and we have before us some tubers perfectly sound, and as large as a medium sized apple, which we took from a haulm that was withered and flaccid. It appears to us that the roots and the underground portions of the haulm were the first to become affected, the cellular cortical portions being the first to show signs of decay; if severely so, then, of course, no tubers are formed, but if partially so, then tubers may be formed. The leaves seem to be affected subsequently to the underground portions; they become spotted with brown spots, the colour of which is deeper on the upper surface, and by and by the whole leaf withers and dries up; the lower leaves are first affected, the tops remaining green after the lower ones are dead. Microscopical examination has revealed to us nothing but the brown coloured tissue and brown masses, consisting probably of altered protoplasm. We have not been able to

detect either fungus or insect." Destruction of all infected plants is recommended.

In same periodical and number (p. 16—17) was included a note from Berkeley on same disease. „The disease appeared, he writes, the previous years but did not attract much attention. The Early rose within four days, had flourished, wonderfully, and was producing good sized tubers, but the condition is now entirely altered, the rapidity and degree of disease depending on the comparatively decomposed set. Where the set has become deliquescent spots first appear at the base of the haulm, discoloured and crocking the haulm at once decays, as the peculiar spots appear on the leaves; where the set is still comparatively healthy no spots appear on the base of the stem, but the diseased condition is strongly visible on the leaves. I have carefully examined the leaf-spots, and though occasionally I find one or two bodies which I can refer to nothing save Protomyces, they are so inconstant that they cannot at present be asserted to be the cause or justify one in saying that the disease is likely to be propagated by spores". He states further that it may prove to be a constitutional disease and points out that it must be established first whether the disease spreads over the healthy plants and whether it differs from the „curl" which seems to be unknown to the existing generation. In a foot note he adds however: „It seems almost certain that it (the new disease) is the same disease which was formally prevalent in this country, especially in the North, where it was too well-known under the name of „curl". One singular point is that in some cases where the disease has commenced below there is an effort to make a new growth, one side of the stem alone being diseased".

Somewhat later of same year there appeared in same journal another note on the „New potato disease". In it is stated that this disease attacks only American varieties from home grown seed. All grown from seed imported directly from the United States are perfectly healthy. „In all cases, there is the arrested paralized growth, the leaves unhealthy and curled, and covered above and beneath with numerous small dark spots. A good number of the plants were lifted and the roots examined, and in only two cases had the seed tuber rotted.... At the point where the shoots grew out from the eye it appeared to be as healthy as could well be desired; but at the distance of from 1 to 2 inches from the set the stem of the foliage was rotted through to the centre, and so thoroughly was the centre rotted in some instances that it suggested the question whether the malady arose in the interior of the stem and came outwards".

Dean on July 17 of same year reports, that contrary to other observations, he has seen the disease also on plants from seed brought directly from America, namely on Thorburn's Paragon. Of the disease he writes: „this form however differs materially from any I have hitherto seen, as the haulm generally was at first robust and healthy, but within the last 10 days I have observed that the axils of the leafstocks blackened, then gave way, and eventually the whole of the foliage on a stalk fall off, leaving only a bare diseased stem. This appearance is confined to this variety only." He opposes the idea that insects are the cause of the disease.

P. Smith in 1875 observing the „New disease" of potato in England and wishing to find out whether it was present on the continent of Europe, published a paper in Germany on this subject. In this paper, discussing the recent works of Berkeley and other Englishmen on this subject, he states that the unusually dry season may have probably contributed much to the destructiveness of the disease as the plants did suffer much from the drought and some even died as result of it.

In the Journal of Horticulrture of 1875 there appeared several short notes on the „New potato disease" in which besides brief descriptions of the disease is stated several times that this disease is same as the curl of former days.

In Germany the same disease, which has been noticed in the previous years as well, attracted considerable attention in 1875 and a series of papers appeared on this subject the same year.

The editor of the Deutsche landw. Presse writes in this periodical that the variety Early Rose is the one commonly attacked and to such a degree that its growing has to be given up. The disease is to be seen on the plants as early as the second part of May. Some of the plants die soon after and send out new shoots but do never form any tubers. In this paper he includes a note from Drechsler in which the latter gives the following description of the disease: „The leaves of single vines while not yet fully developed become brown spotted, the stems become also rusty, shrivel up and in short time, 10—14 days, the whole foliage, excepting perhaps some of the stems, disappears completely." That is to be seen as early as the beginning of June. In some cases only single shoots from one hill do get infected. Drechsler could not find any mycelium or fungous spores in the infected plants.

Deetz, same year, describes under the name Kräuselkrankheit

some potato troubles, but it is not possible to tell what disease or diseases he had to deal with. He states that the leaves of the infected plants in some cases take on a pink to violet color, describes further this disease in a way that reminds us of stipple-streak and early blight, also of insect injuries. He is of the opinion that aphids are the cause of the disease.

Hallier came out in 1875, 1876 en 1878 with several papers in which he tried to explain the cause and nature of the Kräuselkrankheit of the potato plant. „The disease, he writes, attacks preferably the potato varieties with tender skin and foliage. The so far entirely healthy foliage becomes spotted with small round and black spots, which increase rapidly in number and size. At this time the tips of the leaves become yellowish and wilt, their edges curl and shrivel together, at this moment the leaves and stems are extremely brittle and break like glass when bent. Soon the whole infected shoot wilts from the top down and becomes black. The degree of infection varies considerably. Sometimes the tubers do not germinate at all or the young shoots die soon after; in other cases the shoots die shortly before flowering, or flower sparingly. It is very noticeable and differing from all other potato diseases, that often only single shoots of a seed tuber are attacked, while the others remain entirely healthy and give a good yield." The disease apparently does not spread from one plant to another. In all portions of the infected stems he finds a fine mycelium, which at first is white and later takes on a dark color. This fungus is supposed to pass from the infected stems into the stolons and the young tubers.

He distinguishes two forms of the disease. The form described above is the first form of the disease. When the tubers of such plants were planted the following year he got decidedly abnormal and dwarf plants. Some of the tubers did not germinate at all, others produced small shoots which died immediately after, still others formed unusually thick stems but they were very abnormal and bent, the petioles bent strongly downwards and so did the leaves, the edges of the latter become curled and wavy but never wilt, leaves and stems are as brittle as glass. The leaves are abnormal and die before reaching full development. The shoots usually die before long and only seldom remain alive for longer time. This dying of the shoots is usually very rapid, almost sudden. Such plants never form tubers. Thus the disease covers only two generations.

In the plants of the second form of the disease he could never

find any mycelium. And so he takes it for granted that all other workers, who have claimed and do still claim that no fungus is associated with this disease, must have studied only the second form of the disease. Hallier as will be seen later in the first form of his disease has studied cases where the Kräuselkrankheit has been mixed with Verticillium, Fäsarium and possibly with Rhizoctonia. In his first paper he describes the mycelium he finds in the infected plants as *Rhizoctonia tabifica*, in his later papers as *Pleospora polytricha* Tul. He made no cultures or infections and comes to the above conclusions simply because he found the perithecia of the above fungus formed on the infected and dead stems, which is a most common thing after the death of the stems of most plants and weeds. Hallier's illustrations of the two forms of the disease are very good and show conclusively that in both cases, he had to deal with the disease now commonly known as stipple-streak.

Oehmichen in 1875 describes the Kräuselkrankheit as described by Kühn and later by Hallier. Out of 512 potato varieties, which he examined, only 20 varieties did show the presence of the disease. He also states that the varieties with light green foliage and fine epidermis suffer most from this disease. As control measure he recommends the use of healthy seed. He finds no fungus associated with the disease.

Schenk in 1875 also describes the Kräuselkrankheit as described by Kühn and agrees with him that no fungus is to be seen in the infected portions. Schenk also saw the primary form of the disease as described by Hallier. The cause of the disease he sees in a disturbance of the assimilation processes of the plant, the actual causes of which must be established yet.

Schenk emphasized also the necessity of strict defining and usage of the name Kräselkrankheit, which should be used for the disease described by Kühn and should not be used for other diseases and injuries of the potato plant which may resemble this disease in one or another way.

Schnorrenpfeil in 1876 discussing the Kräuselkrankheit reports that the absolute and specific weight of tubers from stipple-streak plants is much lower than that of tubers from healthy plants. The earlier the plants die from the disease the lower are these weights. He states also that as a rule tubers from sick plants give rise to sick plants and that healthy seed must be used as control measure.

Heimann in 1876 states that the Kräuselkrankheit appeared

on young seedlings even more severely than in other plants of same (?) variety.

Dreisch confirmed in same year the observations of Schnorrenpfeil that tubers from diseased plants give as a rule stipple-streak plants. He finds that cutting the seed increases somewhat the percentage of stipple-streak plants, and states that smaller tubers give a larger number of sick plants than large tubers.

Sorauer in 1877 reviewing the literature on Kräuselkrankheit of the year 1875 states that the real cause of this disease is not a fungus, but that it lies in a defective constitution of the plant itself, which shows itself already in the composition of the seed tuber. An analysis of the healthy and diseased tubers of same size from closely standing plants of same variety showed that the tubers from the diseased plants of same age had very much more potassium than the healthy tubers. The lower percentage of dry matter of the diseased tubers shows, according to Sorauer, that the tubers had remained in a young condition which is inherited.

De Jubainville and Vesque in 1878 describe the stipple-streak disease of potato under the name „frisolée" and „maladie frisée" as follows: „The foliage becomes discolored, the petioles turn down towards the base and roll up completely, the leaves are curled, irregular and covered with elongated spots, these spots increase in size and number and are to be seen also on the petioles and stems. They are at first superficial, later penetrating into the interior of the stem. No tubers or only very small ones are formed. The disease appears after rain in June and July." The authors state that this disease has been considered as a degeneration of the plants due to continuous asexual propagation, but that it has been shown that seedlings are just as severely attacked by the disease. The cause of the disease they see in a too nutritive soil solution and recommend as control measure the use of well decomposed manure and planting of potatoes only on well drained and high lands as recommended by Sorauer.

Reinke and Berthold in 1879 published their work on potato diseases in which they discuss at length the Kräuselkrankheit of this plant. In most of the earlier works, even though they were quite short, it was still possible to recognize with certainty the stipple-streak disease. In this work however, while we recognize with certainty the stipple-streak disease of the potato plant, we recognize also with certainty that the authors were

mixing up two distinct and different diseases, just as Hallier had done. For this reason the writer feels compelled to cite at length some portions of this work in order that the reader may see for himself how the question stands.

The authors distinguish three forms of their disease which they name with the letters A, B and C, and describe as follows:

„A. Towards the beginning of July there appeared the first signs of the disease, which showed itself on some otherwise absolutely normal and vigorous plants. Their lower leaves began to wilt and dry up, usually taking on a yellow color. Curling of the leaflets appeared only in small degree or not at all. No black spots were to be seen on the leaves constantly and when so, only in limited numbers. There were found numerous stems, the leaves of which were wilted and yellow, but not a single brown spot was to be seen on them. In no case did the stems of such plants and only seldom did their petioles show an apparent brittleness. The different shoots of a hill usually did not wilt at the same time, but one after another."

Upon examining sections of so wilted stems they found that the vascular bundles were colored slightly yellow and were full of a heavily branched mycelium, this mycelium was seen in both kinds of vessels but usually in the reticulated vessels. They could follow these mycelia from the base to the very top of the infected plants, which was true in some cases even of the still apparently healthy shoots of same hill. Tnis fungus they described under the name *Verticillium albo-atrum.*

B. This type is to be seen at the same time as A. In this type they find already the symptoms of the third or most advanced stage of the disease. Here also before the middle of July the infected plants are not to be distinguished from the healthy ones, they also reach the size of the healthy and fully grown plants. Stem and leaves are normally developed and apparently healthy. With the appearance of the disease the edges of the leaves begin to curl, but never as bad as in C., there appear brown spots on them, the size of which becomes bigger and bigger, until at last the whole leaf dries up. The petioles are also bent down and there appear on them as well as on the stems discolorations, which result in a sudden wilting and drying up of same. Leaves, petioles and stems are brittle but not so much as in C. The stems, all of which as a rule get diseased, yet not at the same time, show on their underground portions large brown spots and not seldom even longitudinal splitting of the bark. The roots, also show symptoms of the disease. The tubers formed on such plants are less numerous and smaller in size. The microscopic exami-

nation of such plants showed that all portions of the plants above the ground are entirely free from mycelium. In the discolored underground portions, however, a mycelium was always present but only in the parenchym of the bark and never in the vascular bundles.

C. This form appears only on plants obtained from tubers of group A and B. Such tubers which carry in itself the disease and which are usually small, send out in spring shoots which show immediately all the symptoms of an advanced stage of stipple-streak: Such shoots appear later above the ground, develop slower, remain short; the leaves never reach full development, remain small, are drawn together, and do not show the healthy geern color. The leaflets are curled and bent, the main petiole is also bent down. After some time there appear on the leaves and petioles discolorations and black spots. The lower leaves dry up first, the higher standing follow then. At this time there appear black spots also on the stem, at first at the axils of the wilted leaves, then in other places as well, until the whole stem wilts and dries up beginning from the top. If the seed tuber is not exhausted there may be formed new shoots after the death of the first, but they also die before flowering and before forming any tubers. Between the appearance of the first and last shoots from a larger seed-tuber there may pass a long time.

Stems and petioles show by this form of the disease a very high degree of brittleness and break like glass.

Here also no mycelium is found in the portion of the plant above the ground, but here too, as in the case of B., a mycelium was found in the browned cortex of the underground portions of the infected plant.

The first two forms of the disease may appear on one and the same hill and even on one and the same shoot. The tubers of both forms give rise to plants of the third group.

It is more than evident from the foregoing that in the first case the authors had to deal with the Verticillium wilt of the potato, in the second with the primary, in the third with the secondary form of stipple-streak.

They were able to produce experimentally the first form but failed to produce the second form.

Kirchner in 1890 and 1906 describes the Kräuselkrankheit as described by Frank. His illustration of the disease, though poor, shows beyond any doubt that the disease which he describes under the above name is identical with stipple-streak.

Frank in 1896 and 1897 published the results of his observations and studies on the Kräuselkrankheit, which, on account of the fact that the disease attacks the whole hill, he called also „Staudenkrankheit" or vine disease. In what was called at the time „Kräuselkrankheit" he distinguishes several diseases which he considers as closely related, „as there are seen often intermediate forms", yet they are in themselves distinctly different and in some of them even the curling was absent. So that he tinks it undesirable to apply also to them the name „Kräuselkrankheit". For that reason he suggests for all of these diseases the common name of „vine disease". Following is his description of the various forms of this disease, most of which represent forms of stipple-streak.

„1. Real Kräuselkrankheit with downwards bent leaves and dark brown spots, which come out on the lower side of the leaf veins. The whole plant remains smaller than the healthy ones, has not the healthy green color and is distinctly curled. The leaves are often peculiarly brittle. All leaves according to their age take on the above symptoms and that as soon as they appear from the growing point of the stem. The leaves break off easily and die after reaching a certain age. Here are characteristic the small dark brown spots which appear on the leaves even while they are still perfectly green and vigorous. These spots are usually found on the veins of the leaves and most commonly on the lower side of same. From the veins the black spots extend in the surrounding leaf tissues. Such elongated spots can be seen also on the lower side of the petioles and even on the stems, which sometimes reach as far as the base of same and even down along the stolons and young tubers. No fungus is present in any of these spots. The spots and dead cells on the lower side of the leaf veins and petioles are the immediate cause of the curling and bending of same as the growth of the upper portions proceeds more rapidly than that of the lower". This form is, according to Frank, the most common one and has been known for a long time as Kräuselkrankheit. This form as seen from the above description represents beyond any doubt secondary stipple-streak.

2. Real Kräuselkrankheit. This form is exactly the same as the first except that here the black spots are limited to the veins of the leaves.

This form resembles very much the crinkle disease of potato.

3. Real Kräuselkrankheit. This form resembles completely the first form except that no black spots are to be seen whatever, not even on the veins. As a rule the leaves do not die in

this case as rapidly as they did in the first and second case.

From the above it seems evident that in this case Frank has had to deal again with crinkle or advanced cases of potato mosaic which resemble somewhat the secondary form of stipple-streak.

4. „Staudenkrankheit without typical curling of the leaves but with small black spots. Here the spots are formed entirely in the mesophyll between the veins. The veins remain normal and there is no curling of the foliage. The shoots here are not so short as in the case of the real Kräuselkrankheit. But here also as in the first three forms all shoots of a hill do eventually get the disease and the careful observer cannot but notice that there are in the fields intermediate forms between this and the first form, where the spots appear sometimes more on the veins in others more between the veins, which shows the close relation of the various forms of this disease". This form of the disease is nothing but the primary form of stipple-streak.

5. „Pockenflecke" of the leaves. Here Frank describes the early blight of potatoes which he supposed to be also a form of Kräuselkrankheit.

Frank is of the opinion that the cause of the Kräuselkrankheit is not a fungus and that it lies in the plant itself, which is shown by the fact that only certain varieties, Liebscher for instance, are attacked by it while other varieties remain perfectly healthy.

Prillieux in 1897 briefly described the „frisolée" disease of potato as follows: „The plants are dwarfish, the leaves are small, abnormal and curled. On the stem, petioles, and leaves there appear black spots, at first superficial then extend in the interior of the stem, the leaves wilt and the plant dies completely". He then discusses Schenk's (?) opinion that an Alternaria sp. is the cause of this disease and states that it must be established yet whether it is the real cause or only a saprophyte, appearing on the diseased plants.

Sorauer in 1897 described a potato disease under the name „Stippfleckenkrankheit" which is nothing but the primary form of stipple-streak. The disease is characterized by the appearance of numerous small angular black spots on the leaves of the otherwise healthy and normally developed potato plants, it spread rapidly on a variety with lighter foliage and less so on a variety with darker foliage.

The lower leaves died and became brown while single plants died completely. The upper leaves have a healthy green color or are slightly yellowish and are always covered with more or fewer black spots. Often the upper leaves are more spotted than

the older leaves. The spots are irregularly spread over the leaves, have a dark brown to black color and are small and angular, dry, and on both sides of the leaves, sometimes running along a vein, thus forming a black streak over the green leaf. In two cases he saw a mycelium in such spots in one case he saw no mcyelium.

SECOND PERIOD. 1900—1922.

Coming to the literature written on stipple-streak after the year 1900 we see an entirely different situation: Whereas during the preceding one hundred and twenty or more years the stipple-streak disease of the potato plant was always known and considered as a distinct and different disease, in its nature being understood to a certain extent, it now, in spite of the fact that it continued to appear and in some years even did considerable damage, suddenly ceased to exist as such in order to reappear again in various countries and in many papers as a „new" and „unknown" disease, to which more than half a dozen new names have been given, our present knowledge of which being as limited as that of our predecessors of the eighteenth century.

It is very discouraging indeed to think that during a period of one hundred and twenty years of extensive and careful observations and studies, in which have taken part so many and so prominent workers no light could be thrown on the nature and cause of the stipple-streak and related diseases of potato beyond the fact that it is a systemic disease, that it is transmitted with the seed tubers, and that the plants once infected, including their progenies, never recover from the disease.

Sorauer's last words on this subject written at the beginning of the present century may serve perhaps as an illustration of the above and as a summary of all studies on this subject up to the beginning of the second period in the studying of running-out diseases of potato:

„Über die Kräuselkrankheit bringen die eingelaufenen Berichte keine neuen Mitteilungen, sondern nur Bestätigungen älterer Angaben, von denen der Mangel von Parasiten wohl die Wichtigste ist. *Wir sind über die Ursache der Kräuselkrankheit noch durchaus im unklaren.*[1]) Für die Ansicht, dass die Krankheitsursache bereits in der Mutterknolle zu suchen sei, deren einzelne Augen bei ihrer Anlage schon den Krankheitskeim mitbekommen, spricht der Umstand des platzweisen Auftretens einzelner

1) The italics are mine.

kranker Exemplare zwischen den gesunden Reihen und das Erkranken einzelner Stengel an derselben Staude".

„It seems enveloped in an impenetrable mystery", wrote Billingsley in 1792 regarding the cause of same disease.

This very fact perhaps made the desire to understand and explain this „mystery" so much greater among the workers on this subject, that it led to the setting up of an endless chain of most opposing and varying theories and most impossible explanations regarding the cause of the disease. As an example of this can serve no one better than Sorauer himself (1904). This able phytopathologist and most illustrious representative, if not founder of the school of predispositionists, which almost revolutionized the phytopathological science, in his desire to explain the nature and cause of the Kräuselkrankheit, a subject which has interested him for over 30 years, was led to believe, evidently after discharging all other possibilities, that the cause of the Kräuselkrankheit lies entirely in the environmental conditions: „Man braucht dabei nicht an Parasiten zu denken, sondern kann sich auch vorstellen, dass zur Zeit, als einzelne Knollen angelegt wurden, ungewöhnliche Ernährungsverhältnisse (hochkonzentrierte Nährlösung, Wasserarmut u.dgl.) vorhanden gewesen sind, die eine schwächliche Anlage der Augen veranlasst haben. Wenn derartige Augen im nächsten Jahre unter besonders günstigen Wachstumsbedingungen austreiben, so kann die Entfaltung der Triebe normal stattfinden. Wenn aber ungewöhnliche Witterungsverhältnisse, wie z.B. grosse Hitze und Trockenheit im Boden, die in der Anlage schwächlichen Triebe beeinflussen, dann wird der Stengel sich wenig strecken und das Laub sich in geringem Masse nur entfalten können. Aehnlich wie bei den Salzpflanzen kommen dann Verkürzung der Achsen und glasige Beschaffenheit nebst Brüchigheit zustande." This explanation of the cause of potato stipple-streak and related diseases has been upheld in one or other form by numerous workers during the last fifteen years and is accepted as correct even now by Hiltner and other German workers.

Jones travelling through Europe in 1904 to study the resistance of the potato to diseases saw in Germany with Appel and Sorauer a disease causing spotting of the potato leaves, that was different from the Alternaria leaf spot. In the spots he as well as Sorauer and Appel did not find any fungus mycelium. In the trial grounds of the University Farm at Cambridge-England he saw again the same disease and reports that „there was a considerable difference in the amount of spotting of the

various varieties, but none was altogether free from it." It seems highly probable from the above that Jones has had under observation the primary form of stipple-streak.

Massee in 1905, also in both editions of his book on plant diseases, describes a disease under the name potato leaf-curl, which resembles very well the stipple-streak disease. „The curling of the leaves is usually the first indication of the presence of the fungus, although the base of the haulm is the portion first infected, and the curling of the leaves is due to the ascent of water and food being checked by the upward growth of the fungus mycelium in the tissues of the haulm....

At a later stage, the fungus breaks through the tissues to produce its fruit, which is indicated by the presence of numerous irregular, blackish, minutely velvety patches scattered over the surface of the haulm and leaves.

It has been found that in some instances the mycelium of the fungus passes down the haulm into the tuber. In such cases the mycelium in the infected tuber passes into the sprout and again produces the disease in the haulm and leaves.

Neither the leaves nor the haulm above ground can be infected by the spores of the fungus". Only the young sprouts can be infected according to Massee with the spores of the fungus, which he identifies with *Macrosporium* (*Alternaria*) *solani*. The disease as described here by Massee cannot be the early blight of potato, caused by *Alternaria solani* and it seems very likely that Massee seeing the conidia of some saprophytic Alternaria or Macrosporium sp. on the brown spots of the stipple-streak infected plants has considered it as being the cause of the disease and has mistaken the latter for the early blight of potato.

In 1906 appeared in form of a leaflet Appel's first description of stipple-streak. He considers it as a vascular disease; expressing itself in a rotting and browning of the vascular ring of the tubers and being caused by bacteria, hence his name „bacterial-ring" disease. When such tubers are planted, according to him, one of the following three things may be the result:

1. Part of the tubers though externally normal and in spite of the fact that some sprouts may have been formed on them, the latter are attacked and killed before reaching the surface. Here is to be seen an extensive root or small tuber formation. This, he says, is not very typical of this disease as it is seen also in other potato diseases.

2. Other tubers germinate, the plants reach the surface of the soil but remain small, stunted and die shortly after. On the

lower portion of such plants are seen brown colored ruptures, the leaves of such plants are often but not always covered with black spots and soon fall off. Such plants usually die during the month of June.

3. Still another group of plants develop perfectly normally and not before midsummer single or all of their shoots become covered with brown spots and die. Here also the spotting does not appear always. While the plants of the first two groups usually form no tubers, those of the third group give an apparently normal yield. These tubers, however, are to be feared most as they carry over the disease.

Though Appel saw plainly the two stages of the disease, he did not realize that they represent different ages of same and not different degrees of infection as he supposed. He thinks that apparently several closely related bacteria are the cause of the disease and that they undoubtedly must be present in the soil. They cannot attack the healthy and uninjured plants but enter into the plants only through wounds, especially through the freshly cut surface of tubers by which the vascular bundles are being exposed. As control measure he recommends the use of healthy and uncut seed. His later descriptions of this disease in collaboration first with Kreitz and later with Schlumberger have same content. While it is more than certain from the above and from Appel's photos of this disease, that in this case he has had to deal partly with stipple-streak, it is just as evident that the above name as applied by him covers two distinct diseases, which he himself suspected several years later (1913, p 12). The disease he describes above as seen on the green plant is stipplestreak, the disease seen by him on the tubers on the other hand has nothing to do with stipple-streak and may be the same as the disease described several years later by Smith (1911) and Spieckermann (1914).

It seems from Appel's works (1906—1907) that the name Kräuselkrankheit at that time has been used quite indiscriminately for designating several different diseases. These diseases he together with his collaborators describes in 1906, 1907 and 1913 as:

1. Kräuselkrankheit proper, expressing itself in a marked shortening of the stems, crinkling of the leaves and a distinct brittleness of the whole plant. This form may represent, as we understand the question to-day, advanced stages of mosaic, crinkle, or stipple-streak.

2. Leafroll expressed in a retarded growth and rolling of the leaves, here for the first time described and named.

3. Bacterial ring-disease as described above, which is in reality the Kräuselkrankheit of olden days plus a bacterial tuber rot disease.

Schander in 1908 trying to verify the above work of Appel came to the conclusion that Appel's ring disease can be recognized only on the plants and that the tubers do not show the symptoms described by Appel. He also observed that in 1907 in some cases up to 60—80 % of the tubers had black or discolored vascular rings in which bacteria were present, yet when such tubers were planted they gave perfectly healthy plants which gave a good yield. He comes therefore to the conclusion that the discoloration of the tubers in those years has been of a temporary nature, being the result of the unfavorabele weather conditions during the summer and that it has nothing to do with the disease as seen on the plants.

In a second work Schander says also that the ring disease as observed on the plants is transmitted by the seed and that the yield decreases so rapidly that already the second or the third year no tubers are formed whatever. Of the cause of this disease he is not certain.

Brandl in 1909 expressed the opinion that leafroll and appel's bacterial-ring disease are very likly different stages of one and the same disease: The first being the lighter the second the more severe form.

Miss Dale in 1912 attributed the „blindness' of the potato tubers, a disease which she has been studying since 1909, to *Verticillium albo-atrum*. The tubers are attacked by the disease on and around the eyes, the buds are destroyed and if the „blind"tuber is cut through the eyes it will be seen that the diseased area is confined exclusively to the eyes and to a narrow zone immediately below the cortex, which is thickened by cork formation. In this zone she found the mycelia of *V. albo-atrum*, whereas the whole of the interior of the tuber remained sound. When thus infected tubers were planted some of them rotted away, some remained sound but produced no shoots, others formed sprouts, which developed into shoots. These at first appeared healthy, but later most of them showed signs of leaf curl and leaf roll, becoming yellow in color, and gradually withering and dying from below upwards. The mycelium of the fungus is not present in the stem and leaves of the plant. The subterranean stems, however, especially those nearest to

the old tuber were covered with elongated brown patches due to *V. albo-atrum*. These brown patches spread from the seed-tuber up to the new shoots and along the stolons.

It is quite evident from the above description of the „blindness" of potato tubers, that Miss Dale worked with stipple-streak, though she had mixed up with it a number of other diseases and attributed it to *V. albo-atrum*, which as a matter of fact is a well known vascular parasite of potatoes, but does never attack the tubers in the way described by Miss Dale. It seems that the fungus she has been seeing has been a secondary organism.

On the leaves of the above plants, however, appeared at the same time a bacterial disease, which Miss Dale described in the same year in a second paper. Here also she seems to be dealing with stipple-streak. The leaves on which she suspected her bacterial disease became somewhat wrinkled, becoming slightly yellow and covered with small brownish spots. In sections of the brown spots of such leaves she saw that the cells were densely filled with „granules" showing active movement, these granules contrary(?) to other cells granules are stainable and were found to be bacteria. Five days later, she writes, the diseased plant showed symptoms of „leaf curl". „The leaves were rolling up at the edges and were going yellow in large patches and the veins of the leaves were turning brown from the edge towards the centre of the leaves. The leaves gradually became more yellow and dropped off, from below upwards." The stems of the plants in some cases were also yellow and covered with elongated brown patches. From the above it becomes evident that she has been working with stipple-streak, even though her description of the disease is such that it leaves no doubt that she has had not one, but several different diseases on same plants, all of which she considers as one disease.

Upon sectioning some of the infected leaves and veins of leaves she saw that in them are always present large stainable tubes, passing through the cells and nearly all ending in cells filled with stainable granules. These tubes begin forming on the surface of the leaves and pass inwards, piercing the epidermis where two adjacent cells are in contact, but never enter through the stomata.

From infected leaves she isolated a bacterium with which she made successful infections and produced same symptoms. It is however very difficult to analize her infection experiments because very few of them were successful and because even in those cases the macro and microscopic symptoms were not in all cases alike and besides this she claims to have made success-

ful infections with a second organism as well, in which case as in some of the former no tubes were seen in the infected portions, though the bacteria were present in the infected cells.

One thing is certain in Miss Dale's work and that is that the disease of potato tubers she describes under the name of „blindness" is stipple streak and that planting stipple-streak infected tubers she must have had besides various other possible diseases also stipple-streak, something which sometimes becomes quite evident from her description. The causative organism of her disease she describes under the name *Bacillus tubifex*.

Orton in 1913 discussing leaf roll, curly leaf and other new potato diseases writes the following of stipple-streak: „Elongated or angular spots appear on leaves, following the veins. The leaves wither and hang dry on the plant, which soondies. Cause unknown". Here he first applies the name „streak" to this disease and from his short but exact description it is evident that he had to do with the primary stage of stipple-streak Orton however did not recognize the secondary stage of the disease and considered it in some cases as curly-dwarf in still others as an advanced stage of leaf roll. That the above is correct and that most of the cases which Orton has considered as curly-dwarf and in some cases even as advanced leaf-roll must have been cases of secondary stipple-streak, is seen from the fact that all the four groups of tubers shown on plate XIII of his bulletin on potato diseases (1914) and representing the yield of curly-dwarf and leaf-roll plants with their pronounced splitting show quite conclusively that they are the tubers of heavily infected stipple-streak plants. This splitting and bursting of the tubers is a common symptom of stipple-streak, especially when the plants are vigorous and the formation of tubers rapid; it has never been observed by the writer on other potato diseases or on what is called by some curly-dwarf. Prof Quanjer who has had under observation for many years a large number of patoto varieties from all parts of the world and infected with all the known degeneration diseases of this plant has also never seen this splitting of the tubers in any other potato disease. Fig. 2 of plate IV of same work can hardly represent an advanced stage of leaf-roll, while the shrunken, hanging and partly broken off leaves, the unbranched stems and the general habit of the plant indicate that this may have been also a case of secondary stipple-streak.

Appel in 1915 expressed again the idea that stipple-streak, which he now also calls streak, is one of the diseases described

in 1897 by Frank under the collective name of „vine diseases". He also thinks that it resembles in some stages curly dwarf, whereas where it is but weakly developed (the primary stage) it does not resemble curly dwarf. He describes the disease as seen on the plants, considers it as a bacterial disease, though the cause, he says, has not yet been discovered and adds, contrary to his first ideas on this question, that it has not been proved whether this disease is transmitted by the seed.

Barrus in 1917 discussing potato streak says that it produces a condition somewhat similar to the degeneration diseases. He saw both phases of the disease without making any distinction between them and describes the symptoms of the disease as seen on the stem and leaves. He saw the disease spread on to the neighbouring healthy plants. „However, an attempt to obtain an artificial infection by the inoculation of healthy plants with bacteria from a culture made from an affected stem was without success". Planting the following year (1916) the apparently healthy tubers from the infected plants he got again the disease, whereas tubers from healthy plants planted with the above as checks remained healthy during the whole season. No other healthy plants were observed to contract the disease that year.

Speaking of the nature of the disease he says: „It is evidently infectious and of a bacterial nature. Careful work should result in the isolation of the causal organism. Apparently this micro-organism can be carried over winter on the seed, and if this be the only way, disinfection should be an effective remedy".

Güssow in 1918 reports stipple-streak from Eastern Canada and the Islands of Bermuda. He describes and pictures typical stipple-streak under the name „Leaf Streak". „The symptoms, he writes, show up very suddenly towards the end of the vigorous growing season and the leaves are quickly killed. At times the leaf stalk will show one or more dark streaks in its interior when it is held up against the light. The trouble looks typical enough for a bacterial disease, but so far, isolations of any kind of organism have proved unsuccessful". The disease is transmitted by the seed-tubers.

Orton in 1920 published his observations on stipple-streak up to date and describes the disease as seen in the first stage. He is of the opinion that: „Potato streak is a disease of the foliage, attacking fullgrown and otherwise normal and healthy plants and frequently progressing rapidly to destroy them", while

the tubers remain normal. In warning that the disease should not be confused with advanced stages of leaf-roll or mosaic dwarfs, or otherwise degenerated plants he says: „There is, for example, a disease not uncommon in our trial grounds, marked by weak, erect stems, from which frequently the spotted leaves fall prematurely, from the base upwards, so that a palm-tree effect is produced." Which is nothing but the secondary stage of stipple-streak.

The cause of stipple-streak he considers as doubtful and thinks that in its appearance and general course it presents striking similarities with some of the well known bacterial diseases, such as *Ps. Malvacearum* on cotton and *Bact. michigensis* on tomato. He adds also: „The writer was confident that bacteria would prove to be the cause, but efforts to isolate an organism have thus far been futile. For the most part plates poured from the discolored areas remained sterile. Colleges have made similar attempts, with similar negative results. It is believed, nevertheless, that eventually an organism will be found and shown to cause potato streak". Orton noticed a marked varietal resistance and that some plants remained entirely healthy, while others directly alongside were destroyed. He observed more stipple-streak on European varieties such as Factor, than in American varieties. The seedlings with large per cent of stipple-streak which he examined were for the most part hybrids of European varieties and this, he thinks, may account for their greater susceptibility.

Murphy in 1920 in an abstract in Phytopathology considers the secondary form of stipple-streak as one of the diseases causing „running out" of potato seed. He gives to it the name „leaf drop" and describes it as follows: „The disease causes extreme dwarfing, gradual death of the leaves from below upwards, and premature death. It may be identical with Appel's bacterial-ring disease and with a trouble described by F. C. Stewart." He states also that there are indications that the disease is of European origin.

Murphy also while speaking of „leaf drop", which is nothing else but the secondary stage of stipple-streak, and which he has been observing for 5—6 years, states in a letter of Nov. 17, 1919 to Prof Quanjer that streak (he means the primary stage of stipple-streak) is a different disease, new for his plots, which he considers as being caused by a bacterium and states that he has been able to produce the disease by inoculating healthy plants with bacteria isolated from streak plants, while

leaf-drop he considers as one of the diseases causing running out and adds „So far we have no proof of any connection between „streak" and „leaf drop" or „crinkle".

Quanjer in 1921 also described briefly and illustrated the stipple-streak disease of potato under the name of streak. In same work is given also his first description of crinkle. The secondary forms of these two diseases are identical with the various „dwarf" diseases of the potato plant.

Schultz and Folsom in 1922 came to the conclusion that streak is „closely related to mosaic and similar diseases of the Irish potato, being frequently associated with them in the field, having initial late-season symptoms in new leaves only, usually spreading to all connected parts of a hill, and spreading to other hills with the production either of late-season symptoms the same year or of tubertransmitted early season symptoms appearing the following year. In 1921 juice from a streak plant applied to 20 mutilated Green Mountain and Irish Cobbler plants caused infection in 19, with typical symptoms appearing in some in 12 days". They expressed also the opinion that the rareness of streak in commercial fields of North-eastern Main may be due to self-elimination.

The writer of this paper in 1922 also gave a detailed description of stipple-streak in its whole development and in all of its forms. A careful reading of this work, also of Quanjer's and Schultz' works on leaf roll, mosaic and crinkle is necessary for the proper interpretation of the older literature on stipple-streak and related diseases of potato.

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CANNA CROSSES I

BY

J. A. HONING

At present it seems to be taken as a matter of fact that after crossing two types that differ in a number of factors larger than the haploid number of chromosomes no independent Mendelian segregation [1]) will take place in the second generation for all factors concerned. But I know that in 1913 when I crossed a variety of *Canna glauca* by one of *C. indica*, fewer genetici were convinced.

The choice of these two types which should differ in more than eight or nine factors (eight or nine should be the haploid number of chromosomes [2])) was a satisfactory one, and with respect to the question perhaps even too good as the difference is probably twenty factors or more as may be suggested by the following description.

Discriminative characteristics.

Organ	Canna indica	Canna glauca
stem	*tall* [3]) about 2 M. stalks keeping close together	short, about 1 M. stalks spread by creeping rhizome (pl.VIII)
leaves	short, longest about 40 c.M., average 33,9 c.M.	*long*, longest about 54 c.M., average 47,8 c.M.

1) I hope Mr. E. LEHMANN (Zur Terminilogie und Begriffsbildung in der Vererbungslehre, Ztschr. f. ind. A. u. V. XXII, S. 236, 1920) will excuse this pleonasm. Mr. LEHMANN is quite right, but video meliora proboque deteriora sequor.

2) KOERNICKE (1903) and STRASBURGER (1904) found 8 chromosomes. HONING (1915) diploid 16, but after KUWADA the number should be 9, diploid 18. See: TISCHLER, G. Allgemeine Pflanzenkaryologie, S. 587, 1922. BELLING (Proc. Nat. Acad. of Sciences, vol. 7, p. 197, 1921): „Most of the Cannas examined were diploid, showing nine dyads before the first division in the pollen-mother-cells, and these in most plants separated into 9 + 9." — In pollen mother cells I also found 9 + 9 chromosomes.

3) See text p. 4.

Organ	Canna indica	Canna glauca
	broad, largest about 16 c.M., average 14,6	narrow, largest about 12 c.M., average 11,4
	with *broad red margin*	entirely green
	shiny	*dull* on account of a layer of wax
bracts	long, ± 30—45 m.M.	short, ± 15—25 m.M.
staminodes	two, the middle one failing	*three*
	deep scarlet	pale yellow with some pink spots
	short, average 59 m.M.	*long*, average 87 m.M.
	narrow, average 10,8 m.M.	*broad*, average 16,2 m.M.
	nearly rectangular to each other	all three almost in one plane
	spoonform	top recurved [1]) (fig. 1)
	stiff, rather thick	noticeably thinner (fig. 2)
style	short, top of anther as high as the stigma or even a trifle higher; selfpollination thereby very easy	long, top of anther 5—6 m.M. under the stigma; selfpollination very improbable (fig. 3)
	broad	narrow
ovary	red	green
fruit	opens by drying of carpels	*keeps closed*
seeds	small, weight of 300 seeds 43,08 gr., volume of same in cylinderglass 57 c.M.^{3}	*big*, weight of 300 seeds 82,89 gr., volume in the same glass 106 c.M.^{3}
	round	*oblong*
	black [2])	mottled black and brown

1) If doubtful best visible on the „first" staminode (st_1 in fig. 827, p. 621 STRASBURGER, Lehrbuch der Botanik für Hochschulen, 14 Aufl.).
2) See text p. 4.

Fig. 1. Spoon form of staminodes of *C. indica* in 4 subsequent stages and recurvate staminode top of *C. glauca*.

The *C. glauca* used for the cross J 4—2 was a second generation plant after repeated selfpollination and similar to the specimens grown from seeds received from Java and to the F_1, other F_2 plants, F_3 and F_4. It has the long and lanceolate leaves of *C. glauca γ rubro-lutea* [1]), much attenuated at the base and the glaucous hue, but not the slender reddish margin, the leaves being entirely green. The flowers have 3 staminodes of a yellow paler than that of the *rubro-lutea*, more like those of *C. glauca β rufa* [2]) but still paler and in stead of having narrow red stripes along the veins it has only some minute pale pink spots along the middle. The latter characteristic is variable, in some flowers it seems to be absent, but never in all flowers of the same plant, i. e. the opposite phenomenon of that mentioned by Miss Marryat [3]) concerning one of her *Mirabilis* crosses. In the labellum and the filament of the anther the pink colour is always distinctly visible. Thereby it differs from *C. glauca* as it is described (very incompletely) bij Mühle [4]).

The *C. indica* R 13—4—3 belonged to the type with broad leaf base and broad red leaf margin [5]) of which R 13 had been a segregating hybrid but R 13—4 a constant „red" type in all its 252 descendants of four generations.

After many failures one fruit with two seeds was obtained

1) Curtis's Botanical magazine vol. 62, no. 3437.
2) Curtis's Botanical magazine vol. 49, no. 2302.
3) Marryat, D. C. E., Hybridisation experiments with Mirabilis Jalapa. Reports to the evolution committee V, p, 34, 1909.
4) Mühle, Arpad. Das Geschlecht der Canna, 1909.
5) Honing, J. A. Kreuzungsversuche mit Canna-Varietäten, Rec. d. tr. bot. néerlandais XII, 1915, p. 5.

from the cross *glauca* × *indica*. One seed was deaf and the reciprocal cross never succeeded so that the entire F_1 consisted of a single individual. It is tall, has a creeping rhizome (but less so than *C. glauca*), long rather broad leaves with a red margin and a covering of wax, somewhat orange-tinted red flowers

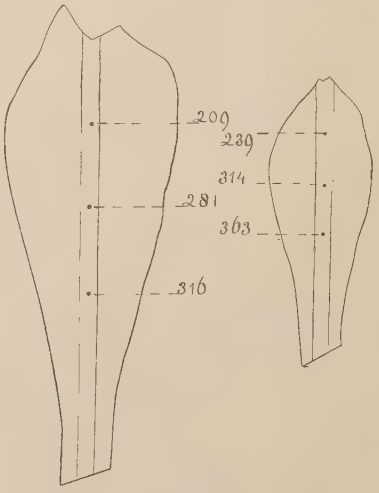

Fig. 2. Staminodes of *C. glauca*, large and thin, and of *C. indica*, small and thick. The figures indicate the thickness in microns, averages from 50 measurements each.

with 3 long broad staminodes with at least partly recurvate tops, a style intermediate in form and position of stigma and anther, red ovaries and big oblong black seeds. The dominant characters are printed in italics. When the indication of dominance fails, the type of heredity is more or less the Zea-type.

Fig. 3. Broad style of *C. indica* with pollen immediately in contact with the stigma, and narrow style of *C. glauca* with pollen half a centimeter beneath the stigma. Nat. size.

Very peculiar is the phenomenon that the dark colour of the seed coat of the F_1 that, in the tropics, covered almost absolutely the brown and black mottling, was less developed in Europe, so that the speckledness was visible and dominance could scarcely be spoken of.

For tallness of *indica* and shortness of *glauca* the behaviour in Europe was changed even more. In contravention of the rule in Sumatra, the *indica* at Wageningen both in 1921 and 1922 was considerably shorter and *glauca* much longer to such a degree that they had interchanged for tallness and shortness.

And as the F_1 remained tall one could say that both types had interchanged for dominance and recessiveness.

There has been raised at Medan a F_2 of 1168 seedlings of which 867 after artificial selfpollination and 301 after free pollination at a time when no other *Cannas* grew in the neighbourhood. Not a single specimen of these 301 was a phaenotype that did not occur also among the other 867 sisterplants. A large number of the 1168 seedlings died before flowering so that the ratios found for many characters may not be exactly the real ones. The deviations from the numbers that could be expected in case of an independent Mendelian segregation, however, are sometimes so considerable that these numbers cannot possibly be reduced to Mendelian ratios, sometimes even on the assumption (for the rest very improbable) that all the dead individuals should have belonged to the type or types of which there was a shortage.

But apart from the deviations the ratios for the same characters are different at different times, notwithstanding the fact that all seeds are gathered from the single F_1 individual. Hereof many instances will be given in the following pages.

Leaf length and breadth.

As the leaf of *C. indica* is short and broad (on an average 34 c.M. length and 14,6 c.M. breadth) and that of *glauca* much longer and noticeably narrower (on an average almost 48 c.M. long and 11,4 broad) one might expect that it should be very easy to distinguish different types among the F_2. So far as the extremes short-broad and long-narrow are concerned, this expectation proves to come true. But for the rest it is impossible to count the numbers of plants with long, intermediate or short leaves. Although very many leaves have been measured and noticed for each plant separately, I have not been able to state for a certainty how many phaenotypes for leaf length and breadth may be present, neither by measuring all the leaves nor by using only the longest leaf of each stem.

The leaf length of F_1 (mean 44,38 c.M.) is almost that of the parent with long leaves, *glauca* (47,76 c.M.), the breadth (mean 14,039 c.M.) almost that of the broad leaved *indica* (14,593): „long" is nearly completely dominant to „short" and „broad" completely dominant to „narrow".

Taking all leaves of the first sowing of F_2 as a whole the mean leaf length (38,135 c.M.) is more like that of *indica* (33,946) than that of *glauca* (47,764) and the mean breadth (11,493) is the same as that of the narrow leaved *glauca* (11,429). The amplitude of variation however is much wider, the limits surpass in

TABLE I. LEAF LENGTH OF CANNA INDICA, C. GLAUCA, F_1 AND F_2.

Length in c.M.	C. indica	C. glauca	F_1	Second generation					
				first sowing [1]			third sowing [2]		
				with red margin	green	total	with red margin	green	total
7–9			1						
10–12	5		1	10	10	20			
13–15	9		3	47	52	99			
16–18	11	4	3	70	91	161			
19–21	8	6	6	98	115	213			
22–24	15	2	3	105	130	235	1		1
25–27	21	4	12	132	158	290	1		1
28–30	28	12	4	154	192	346	2	1	3
31–33	30	12	6	185	230	415	3	2	5
34–36	41	14	12	270	254	524	2	11	13
37–39	**53**	9	14	**297**	**261**	**558**	4	17	21
40–42	46	17	13	270	213	483	6	19	25
43–45	26	29	16	243	201	444	19	20	39
46–48	17	21	17	253	174	427	9	33	42
49–51	3	38	**26**	202	118	320	19	47	66
52–54		**50**	**27**	157	97	254	28	**49**	**77**
55–57		45	13	129	63	192	37	39	**76**
58–60		24	14	81	43	124	**41**	35	**76**
61–63		12	4	32	21	53	31	24	55
64–66		9	6	35	19	54	36	16	52
67–69		1	4	10	4	14	**42**	6	48
70–72				4	3	7	14	1	15
73–75				1	–	1	9		9
76–78					1	1	5		5
79–81							1		1
Number of leaves	313	309	205	2785	2450	5235	316	320	630
Mean	32,946	47,764	44,380	39,584	36,488	38,135	58,394	51,719	55,003
Standard deviation	8,7536	10,8048	12,7888	11,8003	11,413	11,7202	9,8995	8,2429	9,6886
Limits of variation in c.M.	11–50	17–69	9–69	12–73	11–78	11–78	22–80	28–71	22–80

1) All uninjured leaves have been measured.
2) The longest leaf of 10 stems per plant have been measured.

one or in both directions those of *indica* and *glauca* together (table I and II).

Without doubt there exist new combinations of factors for length and breadth in leaves much longer than those of *glauca* that are absolutely but not relatively broader than those of *indica*. Also there appeared a type with leaves shorter than those of *indica* and narrower than those of *glauca*. This and especially the fact that a Mendelian analysis seems to be out

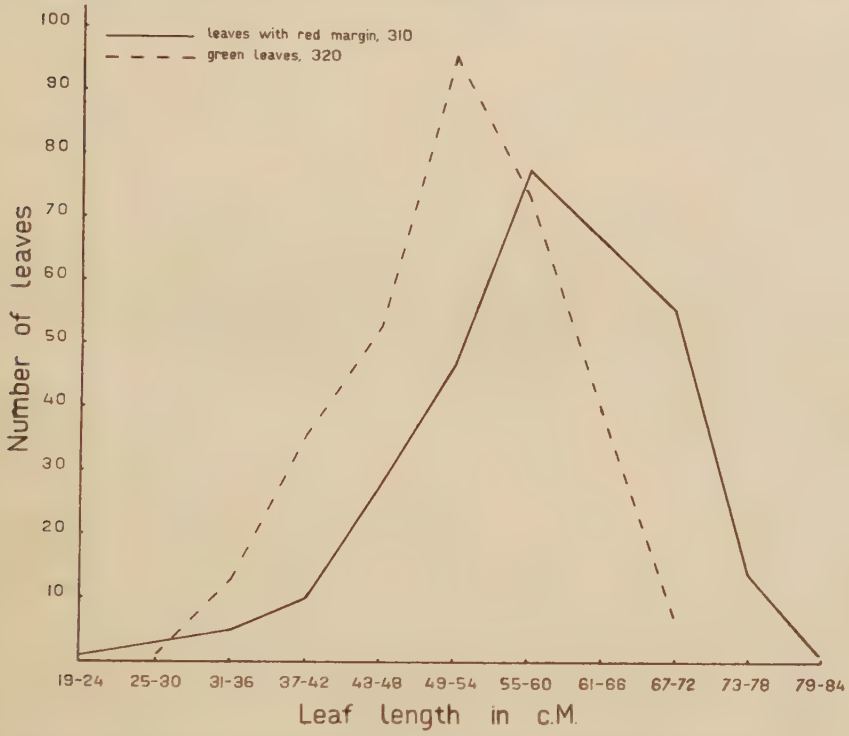

Fig. 4 Difference in leaf length in F_2 between red edged and green leaves.

of the question reminds us for example of the crosses of Egyptian cotton of Cook [1]), Marshall [2]) and Kearney and Wells [3]) and to the *Dianthus* crosses of Wichler [4]).

1) Cook, O. F. Suppressed and intensified characters in cotton hybrids. U. S. Dep. of Agric. Bur. of plant ind. Bull. 147, 1909.

2) Marshall, G. Perjugate cotton hybrids. The journ. of hered. VI, p. 57, 1915.

3) Kearney, Th. H. and W. G. Wells. A study of hybrids in Egyptian cotton. The Am. Nat. LII, p. 497, 1918.

4) Wichler, G. Untersuchungen über den Bastard Dianthus Armeria × Dianthus deltoides nebst Bemerkungen über einige andere Artkreuzungen der Gattung Dianthus. Ztschr. f. ind. A. u. V. X, S. 177, 1913.

TABLE II. LEAF BREADTH OF C. INDICA, C. GLAUCA, F_1 AND F_2.

Breadth in c.M.	C. indica	C. glauca	F_1	Second generation					
				first sowing [1]			third sowing [2]		
				with red margin	green	total	with red margin	green	total
2,5–3				2	6	8			
3,5–4		4		11	33	44			
4,5–5		5	2	35	73	108			
5,5–6	3	4	3	88	112	200		1	1
6,5–7	7	9	3	121	129	250		1	1
7,5–8	6	9	4	175	239	414		4	4
8,5–9	11	23	4	237	**292**	**529**	2	15	17
9,5–10	13	37	7	**273**	252	**525**	1	19	20
10,5–11	13	46	11	252	250	502	6	29	35
11,5–12	18	**55**	18	**294**	217	511	10	31	41
12,5–13	28	51	23	257	214	471	12	**48**	**60**
13,5–14	32	20	25	254	212	466	**28**	30	58
14,5–15	34	22	**32**	204	150	354	22	27	49
15,5–16	**39**	17	24	160	116	276	17	26	43
16,5–17	**40**	8	25	127	74	201	16	19	35
17,5–18	21		6	117	38	155	24	**26**	**50**
18,5–19	23		11	86	27	113	29	16	45
19,5–20	20		2	51	10	61	**33**	8	41
20,5–21	4		4	24	2	26	31	13	44
21,5–22	1		1	10		10	30	3	33
22,5–23				4		4	17	–	17
23,5–24				–		–	17	2	19
24,5–25				1		1	6	2	8
25,5–26							6		6
26,5–27							3		3
Number of leaves	313	310	205	2783	2446	5229	310	320	630
Mean	14,593	11,429	14,039	12,134	10,812	11,493	18,374	14,159	16,233
Standard deviation	3,4103	2,6350	3,1969	3,7170	3,4116	3,6377	3,8569	3,5206	4,2492
Limits of variation	5,5–21,5	3,5–17	4,5–21,5	2,5–24,5	2,5–21	2,5–24,5	8,5–26,5	6–25	6–26,5

1) All uninjured leaves have been measured.
2) The longest leaf of 10 stems per plant has been measured.

The leaves with red margin are on an average longer than the green ones, the difference of the means being 3,096 c.M. When only the longest leaf of each stem was counted of the plants of the third sowing, the „red" leaves were 6,675 c.M. longer than the entirely green ones (table I and fig. 4).

With respect to the leaf breadth it is quite the same thing, the „reds" are in the first sowing 1,322 c.M. broader than the „greens". In the third the difference in breadth between the longest leaves is on an average even 4,215 c.M. (table II, fig. 5).

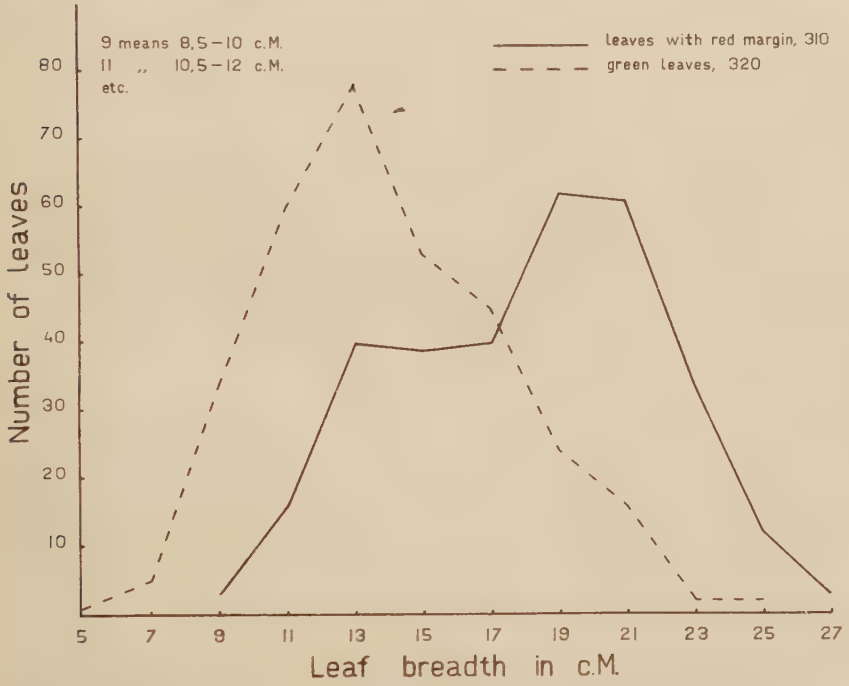

Fig. 5. Difference in leaf breadth in F_2 between leaves with red margin and green ones.

It is obvious that the difference in leaf breadth is relatively greater than that in length so that as a rule the form of the leaves with red edges is broader than that of the green leaves. In the first sowing the curve of the breadth percent of the reds does not differ very much from that of the greens when all leaves are used, namely 0,98 % more. Taking the longest leaf and the one above and that beneath it of ten stems per plant, i. e. 30 leaves per plant, of the same sowing, the difference increases to 2,22 % and in the third sowing, using only the longest leaf of each stem, to 4,09 % (table III and IV). This agrees with the somewhat more robust appearance of the „red" plants,

TABLE III. LEAF BREADTH EXPRESSED IN PERCENTAGE OF THE LENGTH. (F_2 FIRST SOWING, ALL LEAVES MEASURED).

Breadth percent	C. indica	C. glauca	F_1	Second generation			
				with red margin	green	total	‰
9–10							
11–12				1		1	
13–14				14	1	15	3
15–16		2		33	7	40	8
17–18		15		76	27	103	20
19–20		34		78	67	145	28
21–22		48		87	121	208	40
23–24		**60**		163	192	355	68
25–26		**62**	12	181	257	438	84
27–28		44	32	267	320	587	112
29–30		23	37	**331**	**342**	**673**	**129**
31–32		11	**42**	**333**	300	633	121
33–34	2	–	17	293	240	533	102
35–36	4	1	17	256	186	442	85
37–38	19	–	18	207	161	368	70
39–40	43	2	9	155	98	253	48
41–42	**72**	–	10	111	57	168	32
43–44	68	1	8	69	38	107	20
45–46	47		1	48	15	63	12
47–48	30		1	32	10	42	8
49–50	12		1	20	4	24	5
51–52	2			5	1	6	1
53–54	6			12	1	13	2
55–56	3			4	1	5	1
57–58	1						
59–60	2						
61–62	–						
63–64	1						
Number of leaves	312	303	205	2776	2446	5222	999
Mean	42,99	23,93	31,63	30,65	29,63	30,17	

which is possibly only the expression of a beneficial action of the anthocyanin and does not necessarily indicate a coupling of factors for leaf breadth and red margin. The „green" variety of *indica* is also a little smaller in size than the type with red edges.

TABLE IV. LEAF BREADTH EXPRESSED IN PERCENTAGE OF THE LENGTH.

Breadth percent	First sowing. The three longest leaves per stem, ten stems per plant			Third sowing. The longest leaf per stem, ten stems per plant		
	with red margin	green	total	with red margin	green	total
13–15	8	2	10		2	2
16–18	21	13	34		13	13
19–21	28	58	86	4	30	34
22–24	60	97	157	23	43	66
25–27	98	123	221	22	**77**	99
28–30	**186**	**145**	**331**	59	65	124
31–33	**188**	120	308	**96**	46	**142**
34–36	122	50	172	71	25	96
37–39	87	48	135	31	16	47
40–42	41	21	62	4	3	7
43–45	20	8	28			
46–48	10	3	13			
49–51	1	1	2			
52–54		–	–			
55–57		1	1			
Number of leaves	870	690	1560	310	320	630
Mean	31,13	28,91	30,15	31,47	27,38	29,39

In both series of F_2 plants, the „reds" and the „greens", one can choose some specimens with continually increasing breadth percent (fig. 6). The broadest individuals and also the narrowest are „red". (table V and VI). But in this way, too, it is impossible to discriminate well distinct types, a common phenomenon with quantitative differences as Mendel [1]) already has observed. Possibly the difficulty may be still greater when the factors partly would act on size in general, i. e. on length and breadth together, partly on length only and on breadth only.

1) Mendel, G. Versuche über Pflanzenhybriden, p. 7, 1865.

Using Castle's [1]) formula for the number of factors $\frac{\sigma F_1 - \sigma F_2}{\text{mean A} - \text{mean B}} \times 100$ I find in Castle's table II that the difference in leaf length between *C. indica* and *C. glauca* should be one of 21 factors. With the improved method of estimating according to Wright $n = \frac{D^2}{8(\sigma_2^2 - \sigma_1^2)}$ only one factor should be involved (at least if it is allowed to use any formula when $\sigma_2^2 - \sigma_1^2$ is negative).

The F_1 standard deviation for leaf length is greater than that

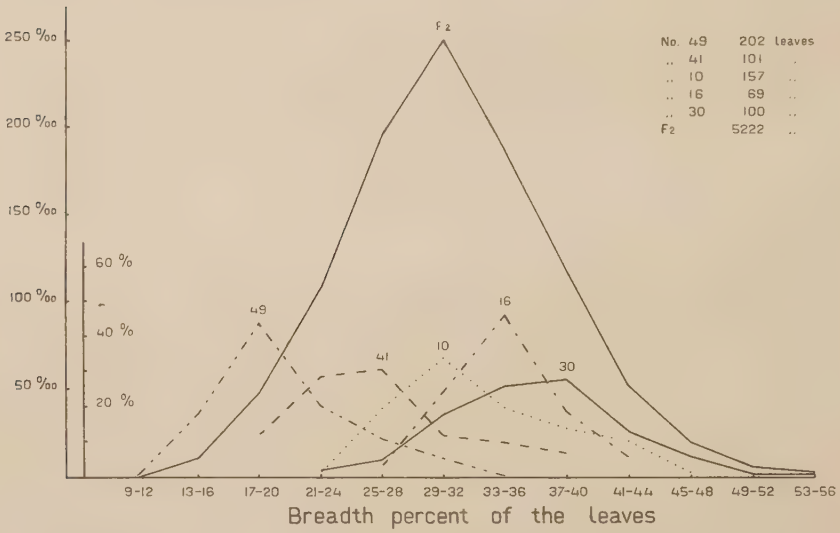

Fig. 6. Breadth percent of leaves of 5 F_2 plants with increasing relative breadth. The number of leaves of every group of percentages is expressed in % of the total number of leaves per plant, for the whole F_2 in $^0/_{00}$ and not sketched on the same scale with the former.

of the F_2, one might say notwithstanding the F_1 is one individual. But one must say just because it is one individual only. The irregularity is caused to a large extent by the fact that the lowest and the highest of the usually 5—8 leaves on a stem are always much shorter and more variable than the others, especially in the types with large leaves. By adding series as: 37 43 52 48 42 22 and 24 40 48 50 55 48 22 and 13 41 52 56 52 35 and 25

1) Castle, W. E. On a method of estimating the number of genetic factors concerned in cases of blending inheritance. Science N. S. Vol. LIV, p. 93 and 223, 1921.

48 59 61 40 etc., all series of F_2 no. 22 or 15 45 53 52 35 and 22 37 48 49 35 19 and 36 45 54 49 40 15 and 47 58 59 45 17 etc., all series of F_2 no. 49, one does not get a regular curve. The curve of most F_2 plants separate is quite as irregular as that of the F_1, for instance of

F_2/no. 22 it is 1 0 1 6 7 3 5 4 4 14 13 19 23 26 16 8 2 1
F_2/no. 18 it is 2 4 4 1 3 1 4 7 5 8 10 22 18 21 16 8 3 1

TABLE V. LEAF BREADTH EXPRESSED IN PERCENTAGE OF THE LENGTH OF DIFFERENT F_2 PLANTS WITH RED LEAF MARGIN.

Breadth percent	No. 49	No. 6	No. 41	No. 44	No. 37	No. 18	No. 13	No. 21	No. 7	No. 30
11–12	1									
13–14	11	3								
15–16	26	12								
17–18	**54**	26	3	1						
19–20	35	**31**	9	9	1					
21–22	21	21	7	23	2	1	5			
23–24	20	14	**22**	**28**	3	1	13	4		2
25–26	16	13	18	**28**	12	8	22	6		1
27–28	6	6	13	23	**14**	25	24	9	3	4
29–30	10	3	7	21	12	**33**	27	22	6	9
31–32	1	3	5	20	11	25	**36**	23	12	9
33–34	–	2	3	14	7	18	20	**26**	12	13
35–36	1		7	9	5	10	15	11	**24**	13
37–38			3	8	4	4	11	13	8	**16**
39–40			4	1	4	8	7	11	7	12
41–42					3	5	5	12	6	8
43–44					1	5	3	3	1	5
45–46					1		3	1	3	5
47–48							3	1	–	1
49–50								2	1	1
51–52									–	–
53–54									1	1
55–56									3	
Number of leaves per plant	202	134	101	185	86	143	194	144	87	100

But for the whole F_2 the curve is regular, the extreme minus variates of the large-leaved plants, dispersed over a wide amplitude, are covered by types as F_2/no. 9 with series as 20 26 33 34 29 17 and 19 30 32 29 21 or F_2/no. 16 with 19 23 22 17

and 16 20 26 23 16. The curves of these types are far more regular:

F_2/no. 9: 4 5 9 12 23 10 12 7 8 3

F_2/no. 16: 1 4 12 20 16 11 4 1

For these small-leaved plants there does not exist the considerable difference between the lowest and highest leaves on one side and all other leaves on the other side, as is the case not only with the F_1 and large-leaved F_2 specimens, but also with the parents *indica* and *glauca* themselves (table I).

TABLE VI. LEAF BREADTH EXPRESSED IN PERCENTAGE OF THE LENGTH OF DIFFERENT F_2 PLANTS WITH GREEN LEAVES.

Breadth percent	No. 56	No. 9	No. 40	No. 45	No. 20	No. 48	No. 61	No. 10	No. 3	No. 16
13–14		1								
15–16	1	7								
17–18	7	12	5	1			1			
19–20	**17**	21	6	21	2		–			
21–22	11	**23**	**25**	21	9		2		1	
23–24	6	9	20	29	14	4	15	2	11	
25–26		6	16	**34**	16	9	18	10	12	1
27–28		6	17	19	**18**	**21**	25	21	21	2
29–30		4	8	14	16	19	**27**	**29**	27	8
31–32		2	9	20	6	12	21	24	**30**	9
33–34		1	5	15	4	10	13	18	19	15
35–36		1	3	5	–	**20**	11	13	18	**17**
37–38			6	3	3	4	9	14	9	11
39–40			1			8	10	8	4	2
41–42						8	4	10	2	3
43–44						4		6		1
45–46						2		2		
47–48						1				
49–50						1				
Number of leaves per plant	42	93	121	182	88	123	156	157	154	69

Consequently: measuring all leaves of all F_2 individuals and adding the figures in one curve is an erroneous proceeding.

At any rate the tables I—VI prove the relatively small value of the statistical methods for genetical analyses.

Anthocyanin in the leaves.

a. The red leaf margin.

It was shown in a previous paper that the difference between the variety of *Canna indica* with a red leaf margin and that with entirely green leaves is one of three hereditary factors, then called **A**, **B** and **C**. The numbers of red and green plants agreed in some cases as well with the ratio 27 : 37 as may be desired, viz. 95 red as against 127 green (theory 93,7 : 128,3) and another time 83 red as against 112 green (theory 82,3 : 112,7). One of the three factors, **C**, could manifest itself separately by a very small red margin only to be seen at close view, theoretically in 21 out of every 37 specimens without broad red edges. In fact it did appear in 30 out of 51 „green" plants (theory 28,9).

TABLE VII. SEGREGATION OF F_2 INTO INDIVIDUALS WITH AND WITHOUT A RED LEAF MARGIN.

Sowing	Sown	Number of seeds	Number of seedlings	With red margin	Green	Theoretically by segregation according to 9 : 7
1	Sept. '14	200	158	83	75	127, 1 : 98, 9 actually 126 : 100
2	July '15	92	68	43	25	
3	Aug. '15	223	202	101	101	
4	Sept. '15	75	60	30	30	
5	Dec. '15	260	233	132	101	131,1 : 101,9
6	March '16	267	232	129	103	130,5 : 101,5
7	May '16	263	215	107	108	
	Total Medan	1380	1168	625	543	
8	Jan. '22[1] Wageningen	263	92	61	31	

1) The low number of seedlings — and probably also the 2 : 1 ratio — is caused by *Rhizoctonia*.

After crossing the red-edged *Canna indica* by *C. glauca* in stead of its own green variety, segregation according to three independent characters did not occur in one of the eight batches in which the F_2 was sown (table VII). Twice the ratio 9 : 7 was observed with very slight deviations (no.'s 5 and 6)

and when the two first sowings are taken together the deviation from 9 : 7 is also small. But in three batches (no.'s 3, 4 and 7) the ratio 1 : 1 is unmistakable. Thus the offspring of a single individual has segregated according to different ratios. There was some suggestion of periodicity in so far as the seeds obtained after pollination and ripening in a dry period segregate according to 1 : 1 and those won during the rainy season according to 9 : 7. For the back cross of F_1 and *glauca* this supposition did not obtain much evidence.

Perhaps Renner [1]) may be right in his suggestion that this variability could be caused by differences in velocity of growth of the different types of pollen as is the case with *Oenothera* [2]). But then the constancy of the irregularity is still incomprehensible.

The mean error for segregation according to 9 : 7 for n = 1168 is 0,2322 per 16. In reality the deviation is 0,4383 per 16 (625 : 543 = 8,5617 : 7,4383). Assuming that the segregations 101 : 101, 30 : 30 and 107 : 108, together 238 : 239, are accidental variations of the 9 : 7 ratio, 0,3634 per 16 would be calculated

TABLE VIII. SEGREGATION OF THE F_3 AND F_4 FOR THE CHARACTER OF RED LEAF MARGIN.

No. of F_2 or F_3 plant	Generation	Number of seeds	Number of seedlings	With red margin	Green	Ratio red : green	Theory
1	F_3	70	48	36	12	3 : 1	36 : 12
6	F_3	67	49	28	21	9 : 7	27,56 : 21,44
7	F_3	33	6	6	–		
7–6	F_4	16	5	5	–		
13	F_3	79	8	6	2	3 : 1	6 : 2
13–2	F_4	3	1	1	–		
14	F_3	21	11	7	4		
18	F_3	101	42	33	9	3 : 1	31,5 : 10,5
21	F_3	22	8	5	3		
28	F_3	5	2	2	–		
30	F_3	116	88	44	44	1 : 1	
35	F_3	9	5	3	2		
37	F_3	84	11	8	3	3 : 1	8,25 : 2,75
37–1	F_4	60	45	33	12	3 : 1	33,75 : 11,25
38	F_3	26	5	5	–		

1) Renner, O. Zur Biologie und Morphologie der männlichen Haplonten einiger Önotheren. Ztschr. f. Bot. XI, S. 305, 1919.

2) Heribert-Nilsson, N. Zuwachsgeschwindigkeit der Pollenschläuche und gestörte Mendelzahlen bei Oenothera Lamarckiana. Hereditas I, p. 57, 1920.

as mean error for n = 477, but actually it is almost three times as large viz. 1,00.

An explanation of a 1 : 1 ratio, if two factors should co-operate, is very easy, assuming the impossibility of the homozygotic dominant form of one of the two factors, e. g. **A**. When all **AA** forms perish there will remain per 16 combinations 2**AaBB**, 4**AaBb**, 2**Aabb** and 4**aa**-forms, i. e. 6 with red margin against 6 without. And it would not be so very strange to search for an explanation in this direction as the F_3 also gives an instance of the 1 : 1 ratio (44 with and 44 without the broad red margin). Moreover there were found after selfing some hybrids 107 specimens with red flowers and 53 with yellow ones, i. e. 2 : 1, whereas on account of the back cross by the recessive yellow type a 3 : 1 ratio was to be expected.

But how can we imagine that one and the same plant should be able to produce repeatedly both homozygous and heterozygous children in succession with only heterozygous ones?

As all 15 selfed F_2 plants with broad leaf margin belonged to the first sowing, the constancy of one or two of them in F_3 and F_4 does not allow of any conclusion. Therefore some individuals

TABLE IX. THIRD AND FOURTH GENERATION OF F_2 PLANTS WITHOUT RED LEAF MARGIN.

No. of F_2 or F_3 plant	Generation	Number of seeds	Number of seedlings	With red margin	Green
3	F_3	8	4	—	4
4	F_3	37	4	—	4
5	F_3	36	0	—	—
8	F_3	42	0	—	—
9	F_3	17	11	—	11
10	F_3	49	4	—	4
10–2	F_4	25	21	—	21
10–3	F_4	107	90	—	90
12	F_3	38	2	—	2
16	F_3	8	3	—	3
22	F_3	42	18	—	18
26	F_3	13	0	—	—
36	F_3	81	58	—	58
37–2	F_4	10	9	—	9
39	F_3	10	4	—	4
75	F_3	113	97	—	97
162	F_3	29	15	—	15
Total		665	340	0	340

of a 1 : 1 segregation had to be selfed and for that reason (among others) the growing of second generation plants was undertaken once more. But then *Rhizoctonia* made a 2 : 1 ratio of it and next year I will try anew.

There is yet another particularity. The factor **C** for the very narrow red edge, in the *glauca* cross, is never seen separately neither in the 543 green seedlings of the F_2 nor in nearly 450 specimens of following generations, nor after back crossing green hybrids by *C. glauca* or after crossing the hybrids by each other, some 900 plants. This leads to the assumption that **C** must be (coupled to **A** or **B**) prohibited or absent and in the *glauca* cross unnecessary for the broad leaf margin.

In the cases of segregation according to 1 : 1 there cannot be any question about a mixture formed by splitting according to the two ratios 9 : 7 and 27 : 37, for in that case some of the green seedlings would have shown that they possessed the factor **C** before they became three months old.

For the same reason the assumption of „crossing-over" with the appearance of partial repulsion for the factors **A** and **B** in combination with absolute coupling of **C** with **A** or **B** is excluded as an explanation for the 1 : 1 ratio, for the **Ab** or **aB** individuals, each almost 25 % of the total number, would have shown with **C** the narrow red leaf margin and this phaenotype is absent.

The F_3 and F_4 do not throw any light either upon the 1 : 1 ratio, which occurs again (table VIII), or upon the absence of the demonstration of the factor **C**. But it is clear that the confusion of the Mendelian segregation involving a large number of factors need not have a permanent effect on the offspring: clean cut Mendelian ratios reappear in F_3 and F_4.

The back cross of F_1 by *glauca* had fairly good results so far as the number of seeds and seedlings is concerned, 150 plants from the cross $F_1 \times$ *glauca* and 374 from *glauca* $\times F_1$ (table X). It does not matter what plant is pollen- or ovule-plant, the ratio red to green is in both cases the same: 1 red : 2,75 green and 1 red : 2,79 green, notwithstanding the fact that the former cross was much less fruitful. As compared with the 9 : 7 ratio of the F_2 there is a deficit of greens as 1 : 3 could have been expected. In this connection the shortage of reds in the 1 : 1 ratio is the more remarkable.

The back cross of F_1 by *C. indica*, far more difficult than that by *glauca*, yielded 79 seedlings, all with broad red margin.

The red edged F_2 plant no. 37, typical by its red staminodes with yellow margin (plate I fig. 5 and 6) produced in F_3 8 speci-

TABLE X. BACK CROSS OF F_1 BY C. GLAUCA. SEGREGATION INTO PLANTS WITH AND WITHOUT RED LEAF MARGIN.

No.	Cross	Number of seeds	Number of seedlings	With red margin	Green	Ratio
361	$F_1 \times$ J4—2—3	12	10	5	5	1 : 1
365	$F_1 \times$ J4—2—3	54	48	12	36	1 : 3
370	$F_1 \times$ J4—2—3	3	2	1	1	
371	$F_1 \times$ J4—2—3	25	23	8	15	1 : 1,87
375	$F_1 \times$ J4—2—3	76	67	14	53	1 : 3,79
		170	150	40	110	1 : 2,75
363	J4—2—3 $\times F_1$	45	42	17	25	1 : 1,47
366	J4—2—3 $\times F_1$	49	43	11	32	1 : 2,91
368	J4—2—3 $\times F_1$	15	15	2	13	1 : 6,50
369	J4—2—3 $\times F_1$	58	55	17	38	1 : 2,24
372	J4—2—3 $\times F_1$	67	60	11	49	1 : 4,45
374	J4—2—3 $\times F_1$	24	23	7	16	1 : 2,29
376	J4—2—3 $\times F_1$	94	92	22	70	1 : 3,18
		352	330	87	243	1 : 2,79
364	J4—2—1 $\times F_1$	3	3	1	2	1 : 2
367	J4—2—1 $\times F_1$	21	20	3	17	1 : 5,67
373	J4—2—1 $\times F_1$	20	18	5	13	1 : 2,60
377	J4—2—1 $\times F_1$	7	3	–	3	
		51	44	9	35	1 : 3,89
Total		573	524	136	388	1 : 2,85
Theory			524	131	393	1 : 3

mens with red leaf edges and 3 with entirely green leaves (3 : 1, table VIII) and after selfing one of these reds there appeared in F_4 33 reds and 12 greens, again 3 : 1. Quite in keeping with this segregation the back cross F_3 37 -1 $\times$ *glauca* J4 –2 -3 produced half the progeny with red edges and half without, viz. 17 reds and 18 greens. This regular behaviour of F_3 37 -1 may be ascribed to its far less heterozygotic nature as compared with the F_1, as it is for instance relatively constant for the characters of wax on the leaves (table XIII) and of the both red and yellow staminodes (although not homozygous for the

intensity and extension of the red), perhaps for the factors for leaf length and breadth, anyhow less heterozygous than the F_1 for these factors,and probably it is heterozygous at the utmost for one of the factors for staminode length.

b. **Red stripes.**

Besides in the red leaf margin anthocyanin occurs also in the form of more or less distinct stripes on the leaf surface as a double line along the midrib and on either side of the veins just as with *C. Warszewiczii* [1]). Often both lines pass over the vascular bundle into each other. The breadth and the intensity of colour varies widely even far more than is evident from table XI as especially the groups „very strong" and „strong" are not homogeneous at all. There occur specimens with red leaf margin but without stripes, and also such as have a red midrib only, deep or light coloured, and also such as show midrib and sideways stripes in different degrees from hardly perceptible narrow stripes to a dark purplish brown over almost half the leaf surface. The figures of the different groups do not give any indication about the number of factors concerned, so that an analysis will be very difficult. The chance of getting a definitive solution of the problem is not improved by the (often) lower fecundity of many a F_2 plant as compared with the F_1.

The following data are at our disposal:

1. *C. indica* has the midrib coloured, partly also the veins.
2. The F_1 shows the red leaf colour much more distinctly than *indica*.
3. As a rule the F_2 plants with the thickest wax layer are the reddest.
4. With one exception all 450 red edged F_2 plants show anthocyanin along midrib alone (63) or along midrib and nerves both (386).
5. The intensity varies widely in both series.
6. The back cross of F_1 by *indica* produced 19 or 20 specimens without red stripes out of 53 or 54, and all 19 or 20 are (with one exception only) without a wax layer.

From 2 and 3 may be concluded that an intensification factor is brought into by *C. glauca*; from 3 that at least one of the factors for wax is coupled with an intensification factor for red stripes; from 6 that the coupling of the intensification factor with that for wax is a very strong one.

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1) Curtis's Botanical magazine 81, no. 4854.

TABLE XI. RED STRIPES ON THE LEAVES.

F_2, F_3 or cross	Development of anthocyanin								
	along the nervures				along the midrib only			absent	Total
	very strong	strong	weak	very weak	strong	weak	very weak		
F_2, 1st sowing	1	27	4	1	–	–	–	1	34
2d „	3	44	18	1	4	9	–	–	79
3d „	3	12	4	–	3	2	–	–	24
4th „	3	28	22	11	2	3	–	–	69
5th „	2	44	16	3	–	3	–	–	68
6th „	3	33	42	6	–	17	–	–	101
7th „	–	16	36	3	–	18	2	–	75
Total F_2	15	204	142	25	9	52	2	1	450
F_3/7	–	1	3	–	–	–	–	–	4
F_3/13	–	5	1	–	–	–	–	–	6
F_3/14	–	6	–	–	–	–	–	–	6
F_3/18	–	9	10	4	–	1	–	–	24
F_3/21	–	1	2	–	–	–	–	–	3
F_3/28	–	–	–	2	–	–	–	–	2
F_3/30	2	27	5	1	–	–	–	–	35
F_3/35	–	3	–	–	–	–	–	–	3
F_3/37	–	8	–	–	–	–	–	–	8
F_4/37–1	4	2	–	–	–	–	–	–	6
F_3/38	1	3	–	–	–	–	–	–	4
F_1 × R13–4–5–1–13 (nr. 381)	3	10	–	–	–	–	–	5[1]	18
R13–4–5–1–1 × F_1 (nr. 382)	–	4	1	2	–	–	–	6	13
R13–4–5–1–13 × F_1 (nr. 383)	6	7	–	–	–	–	–	8	21

1) Probably 6 out of 19, but not absolutely certain.

The simplest interpretation should be given by the assumption that the red midrib and nerves are caused by the factors **A**. **B** (and **C**?) of *indica* as also the red margin, but in a much lower degree and rather variable, and that an intensification factor **G** of *glauca* acts homozygously more strongly than heterozygously. The single F_2 specimen without stripes among the 450 could have been a minus variate, phaenotypically well

judged but genotypically a „mistake". There remains however the possibility of separate factors for midrib and nerve colouring.

Wax on the leaves.

Whether a thick wax layer is present on the leaves as with *glauca* or whether it is absent as with *indica* can be fairly well determined on the young seedlings. But for the hybrids with thin or very thin wax layer the chance of error is pretty considerable until 1 —1½ month after planting out (in the tropics!) and even then there are still some doubtful individuals which are best judged by subsequently formed shoots.

TABLE XII. SEGREGATION OF F_2 INTO INDIVIDUALS WITH AND WITHOUT WAX LAYER.

Sowing	Number of plants with wax; of these			Number of plants without wax; of these			Ratios			
	red	green	total	red	green	total	wax : no wax	r : gr	r : gr; originally	r : gr; without wax
1	29	27	56	6	2	8	7,00	1,21	1,11	3,00
2	24	15	39	11	4	15	2,60	1,84	1,72	2,75
3	75	76	151	22	9	31	4,87	1,14	1,00	2,44
4	22	23	45	2	5	7	6,43	0,86	1,00	0,40
5	104	75	179	10	7	17	10,53	1,39	1,31	1,43
6	92	73	165	14	9	23	7,17	1,29	1,25	1,56
7	72	49	121	17	10	27	4,48	1,51	1,01	1,70
Total	418	338	756	82	46	128	5,91	1,30	1,15	1,78

The number of factors involved seems to be two or perhaps three of polymeric nature. In the F_2 the numbers of plants with and without wax vary widely and the ratios in the various batches show even greater divergence than those of red margined and green leaves (table XII). Clearly there was no independent Mendelian segregation. The latter probably reappeared in 3 cases of F_3 sowings out of 26, but even these 3 are not wholly above suspicion, especially not the 15 : 1 ratio (table XIII). Of F_2/no.75 which promised to give some indications, again a third generation has been raised at Wageningen, and some

F_3 plants were selfed. But *Rhizoctonia* killed most seedlings. 37 only could be planted out from 189 seeds. Therefore $F_2/75$ and some F_3 plants have been selfed anew in 1922.

TABLE XIII. SEGREGATION IN F_3 AND F_4 FOR THE CHARACTER OF WAX.

F_2 or F_3 plant		Third or fourth generation							
		Number of		certainly about	Layer of wax				
No.	wax layer	seeds	seed-lings		thick	thin	very thin	absent	ratio remarks
1	very thin	70	48	44	–	12	23	9	1 : 2 : 1
3	thick	8	4	4	2	2	–	–	
4	„	37	4	3	2	1	–	–	
6	„	67	49	35	33	2	–	–	
7	thin	33	6	4	1	3	–	–	
9	thick	17	11	6	5	1	–	–	
10	„	49	4	3	1	2	–	–	
10–2	± thick	25	21	14	14	–	–	–	
10–3	thick	107	90	68	68	–	–	–	
12	„	38	2	2	–	–	2	–	
13	„	79	8	8	8	–	–	–	
14	„	21	11	8	8	–	–	–	
18	„	101	41	30	26	4	–	–	
21	„	22	8	6	4	2	–	–	
22	thin	42	18	17	–	15	1	1	15 : 1?
28	absent	5	2	2	–	–	–	2	
30	± thick	116	88	71	44	26	1	–	
35	thick	9	5	5	5	–	–	–	
36	„	81	58	48	25	22	–	1	
37	„	84	11	11	11	–	–	–	
37–1	„	60	45	26	26	–	–	–	variable
37–2	„	10	9	8	8	–	–	–	
38	± thick	26	5	4	4	–	–	–	
39	thick	10	4	4	4	–	–	–	
75	„	113	97	76	20	37	4	15	1 : 2 : 1?
162	absent	29	15	14	–	–	–	14	

„Thick" does not always mean the same degree of thickness; most times it indicates a layer of wax less thick than that of C. glauca, but so well developed that it is visible from a distance. The difference between „thin" and „very thin" is sometimes doubtful, likewise „very thin" and „absent".

There is an appreciable repulsion between the factors for red leaf margin and those for wax layer, consequently at least one of the factors for red leaf margin is localized in the chromosome(s?) of *indica* homologous to that (or those) in which

glauca contains a factor for wax. With the exception of the fourth sowing the number of red edged plants without wax is always absolutely and relatively larger than that of the greens without wax, on an average 1,78 times as large, whereas the ratio red to green was originally 1,15 : 1 and by the larger mortality of the green individuals it was changed indeed, but not beyond the 1,30 : 1 ratio.

While the ratio wax to no wax varies from 2,60 : 1 to 10,53 : 1, the ratio red : green among the plants without wax varies from 0,40 : 1 to 3,00 : 1 in the different sowings. Under these circumstances one cannot use the figures for an analysis.

The back cross of F_1 by *glauca* yielded in both reciprocal crosses without any exception only plants with wax (524 seedlings) as was to be expected.

TABLE XIV. BACK CROSS OF F_1 BY C. INDICA. SEGREGATION FOR THE FACTORS FOR WAX LAYER.

No.	Cross	Number of seeds	Number of seedlings	Cert. about	Wax layer			
					thick	thin	very thin	absent
380	$F_1 \times$ R13–4–5–1–1	7	6	4	2	2	–	–
381	$F_1 \times$ R13–4–5–1–13	33	23	19	12	–	1	6
382	R13–4–5–1–1 $\times F_1$	34	23	13	3	3	–	7
383	R13–4–5–1–13 $\times F_1$	29	27	21	11	2	–	8
	Total	103	79	57	28	7	1	21

The back cross with the recessive parent *indica* should reproduce all possible classes of plants heterozygous for the wax factors and the types without wax (table XIV). The figures are too small and too irregular for giving a good idea. Only the nos. 380 and 381 where the pollen was recessive so that no differences in velocity of growth of the pollen tube could cause irregularities, show together a 3 : 1 ratio viz. 17 plants with wax and 6 without. This agrees with the assumption of two polymeric factors, which was also possible on account of the segregation in F_2, F_3 and F_4. The F_1 ovules could be represented by 1 **KL** : 1 **Kl** : 1 **kL** : 1 **kl** in which **K** and **L** both separate and together produce a wax layer.

The numbers 382 and 383 do not affirm this theory. The ratio of 19 plants with wax and 15 without cannot be interpreted in the same way but it does not necessarily contradict the scheme.

Of course differences in velocity of growth of the pollen tubes may have disturbed the ratios.

Comparing the bottom of table XI for red stripes on the leaves and XIV for the wax layer, one is struck by the large number of recessive forms for both sets of factors after back crossing F_1 by *indica* that is dominant for the red stripes and at the same time recessive for the intensification factor and for wax. The 6 specimens of no. 381 without wax are the same as the 6 (probably; certainty for 5!) without red stripes. Of the 7 plants without wax of no 382 5 did not show any red stripes, 2 only to a very low degree. The 8 of no. 383 were quite the same. The back cross proves just as the F_2 the very high degree of coupling between one of the factors for wax and the extension factor for the anthocyanin.

The number of staminodes.

The variety of *C. indica* used. has 2 staminodes as *C. indica β lutea* [1]), *C. Warszewiczii* [2]) and *C. speciosa* [3]). These two are the exterior ones of the species with 3 staminodes. Very seldom, twice out of some thousands of *indica* flowers I have seen the middle staminode developed, noticeably but not very much smaller than the outer ones. More often however a small rudiment is found in the shape of a red filament generally not longer than half a centimeter. *C. glauca* has always 3 staminodes, the F_1 has 3 and the vast majority of the F_2 also have 3.

Two staminodes occurred 9 times out of 672 F_2 plants but flowers with two and three staminodes on one and the same plant were more frequent viz. on 38 plants. The development of the third staminode varies in this group from quite normal to very narrow, 3 to 5 m.M. breadth, and often it is at the same time shorter than the outer ones which may be due to differences in external conditions.

In the first sowing there was one specimen with two and three staminodes among 64 plants, in the sixth there were 10 out of 127, that is five times as many. That the number of plants with the unstable constitution varies rather considerably in the different sowings is clear from table XV.

The ratios of F_2 — setting aside the variation — could be explained by assuming three polymeric factors for more than

1) Curtis's Botanical magazine vol. 46, no. 2085.
2) Curtis's Botanical magazine vol. 81, no. 4854.
3) Curtis's Botanical magazine vol. 49, no. 2317.

TABLE XV. THE NUMBER OF STAMINODES OF F_2 AND F_3.

F_2 and F_3	Number of staminodes				
	Certainty about	> 3	3	2 and 3	2
F_2, 1st sowing	64	6	56	1	1
2d „	33	4	27	2	–
3d „	140	3	131	6	–
4th „	49	–	44	4	1
5th „	178	8	157	9	4
6th „	127	3	113	10	1
7th „	81	6	67	6	2
Total F_2	672	30	595	38	9
(Theory		31,5	567	63	10,5 ?)
F_3/1	22	6	15	1	–
„ /4	2	2	–	–	–
„ /6	18	1	12	4	1
„ /9	5	–	1	4	–
„ /14	8	–	8	–	–
„ /18	22	2	5	10	5
„ /21	6	1	4	1	–
„ /22	14	2	12	–	–
„ /28	2	1	1	–	–
„ /30	39	9	29	1	–
„ /35	5	2	3	–	–
„ /36	28	3	21	4	–
„ /38	2	–	1	1	–
„ /75	72	2	58	12	–
„ /162	14	1	8	4	1

two staminodes. The unstable group with 2 and 3 could contain the forms heterozygous for one factor only and the plant having frequently or regularly more than 3 staminodes could be homozygous for two factors and at least heterozygous for the third. Comparing the found numbers 30 : 595 : 38 : 9 with the theoretical ones 31,5 : 567 : 63 : 10,5 it does not look so bad. But the results of the back cross of F_1 by *indica* do not encourage us to be very tenacious in this supposition. In stead of finding one eighth part of the number of plants with merely two staminodes (**mno**) and three eighths in unstable condition (**Mno**, **mNo**, **mnO**) I found after the cross *indica* × F_1 6 and 16 representatives of these groups against 4 specimens with 3 staminodes; once more there is a shortage of the domi-

nant type. The reciprocal cross with only one type of pollen agreed somewhat better but here also the numbers are too small. Furthermore the single individual with 3 and 4 staminodes suggest that the 30 specimens of that group in the F_2 (table XV) cannot well be regarded as homozygous for two factors and

TABLE XVI. THE NUMBER OF STAMINODES OF BACK CROSSES.

Back cross	Number of staminodes				
	Certainty about	> 3	3	2 – 3	2
F_1 × R13–4–5–1–1	2	–	2	–	–
F_1 × R13–4–5–1–13	17	1	6	7	3
	19	1	8	7	3
R13–4–5–1–1 × F_1	7	–	–	4	3
R13–4–5–1–13 × F_1	19	–	4	12	3
	26	–	4	16	6
F_1 × J4–2–3	128	2	124	2	–
J4–2–3 × F_1	263	7	255	1	–
J4–2–1 × F_1	41	–	41	–	–
J4–2–3 × (J4–2–3 × F_3/10–3)	175	28	145	2	–
(J4–2–3 × F_3/10–3) × J4–2–3 nr. 386	14	–	14	–	–
nr. 387	54	2	52	–	–
nr. 388	3	2	1	–	–
nr. 390	5	1	4	–	–
	76[1])	5	71	0	0
(J4–2–3 × F_3/10–3) × J4–2–1	4	1	3	–	–
(J4–2–3 × F_3/10–3) selfed nr. 391	44	10	30	4	–
nr. 392	40	12	28	–	–
nr. 395	43	12	31	–	–
	127[1])	34	89	4	0

1) It is not quite certain whether the numbers may be added as belonging to the same ratio.

at least heterozygous for the third as the single plant of table XVI should be **MmNnOo.**

The numerousness of the recessive form in the back cross could again be ascribed to differences in velocity of growth of the pollen tubes. But this supposition is only a change of difficulties as it remains incomprehensible why there are no more recessive forms in the F_2. The figures do not give an explanation.

F_2/no. 16 with 2 staminodes in all flowers was, after selfpollination, sterile. After free pollination it yielded in some months 8 seeds of which 3 germinated, but all three seedlings died before blooming. F_2/no. 57 with two and three staminodes was also almost sterile.

That no independent Mendelian segregation occurs but partial coupling of the factors for colour and number of staminodes will be discussed later on.

The length and breadth of staminodes.

The staminode length of *C. indica* differs considerably from that of *C. glauca*, the parental ranges do not overlap (table

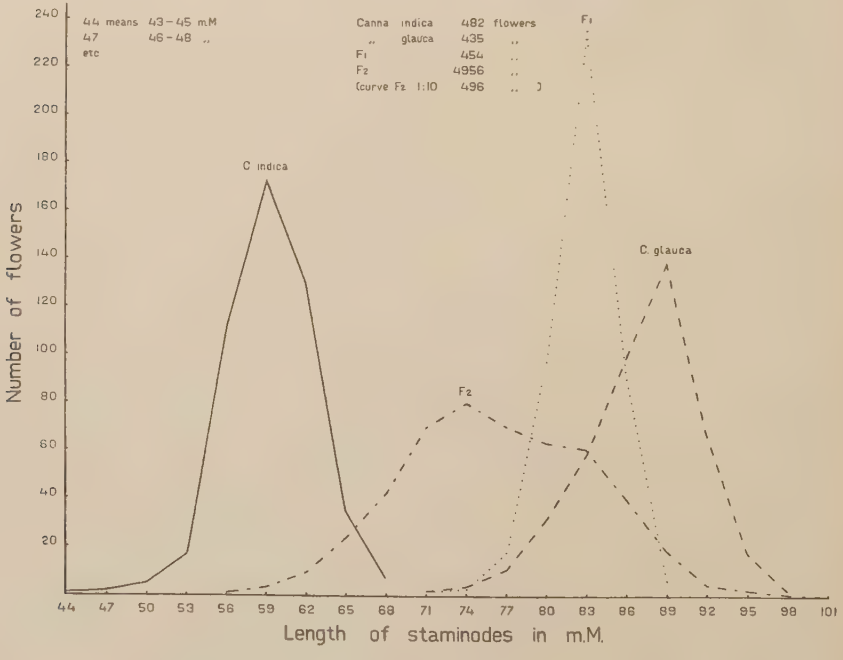

Fig. 7. Staminode length of *C. indica*, *glauca*, F_1 and F_2.

XVII). In the former species it varied from 45 to 69 m.M. and the average length of 482 flowers was 59,3 m.M. For

TABLE XVII. LENGTH OF STAMINODES.

Length in mM.	indica	glauca	F_1	Plants of second generation no.								Second generation				Average length of the back cross of F_1 by	
												sowing			total		
				16	10	3	38	36	22	4	1	1st	3d [1])	4th [2])		glauca	indica
43–45	1																
46–48	2																
49–51	5																
52–54	17																
55–57	112			1								2	2	5	10		1
58–60	**173**			8								10	3	14	35		5
61–63	130			28	1	1	1	1				40	10	29	99		4
64–66	35			71	3	8	4	1	1			110	32	51	240		8
67–69	7			**76**	37	23	13	–	–			219	55	72	428	1	**11**
70–72		2	2	15	**128**	58	53	2	1	1	3	434	72	108	706	7	5
73–75		4	3		58	**61**	**72**	6	3	3	1	**502**	**110**	122	**804**	11	6
76–78		11	18		2	12	11	44	14	13	–	426	94	**132**	709	27	3
79–81		32	97			1		**82**	**52**	37	4	353	79	**132**	636	53	2
82–84		59	**235**			1		18	47	**71**	23	327	67	**132**	612	74	
85–87		100	93					1	7	29	**40**	205	59	94	404	**101**	
88–90		**139**	6								30	108	24	33	189	58	
91–93		68									4	15	7	21	46	43	
94–96		18										1	5	19	26	19	
97–99		2											1	10	11	9	
100–102														1	1	1	
Number of flowers	482	435	454	199	229	165	154	155	125	154	105	2752	620	975	4956	404 plants	45 plants

1) 10 flowers per plant. 2) 25 flowers per plant.

TABLE XVIII. BREADTH OF STAMINODES.

Breadth in mM.	indica	glauca	F_1	Plants of second generation nr.												Second generation sowing			
				3	12	16	39	38	10	36	14	4	1	25	9	1st	3d[1])	4th[2])	Total
8	9			1	1											2	2		4
9	30			5	4			1								12	3	7	25
10	120			12	7	10		2		1						35	29	27	94
11	**217**			**85**	**28**	76	2	4	1	–						205	33	21	288
12	95			56	25	**92**	16	7	3	3		1	1	2		246	74	54	445
13	7	9		5	3	21	**60**	46	31	2		11	1	1		270	**109**	104	557
14	2	28	3				25	**83**	**122**	56	18	24	4	3	1	549	80	141	853
15		80	20				1	10	64	**79**	**37**	**55**	13	2	–	**577**	**90**	**198**	**962**
16		**149**	190					1	7	14	2	**53**	**47**	3	2	419	73	180	784
17		99	**215**						1		1	10	35	20	7	244	50	95	455
18		45	24						1				4	**24**	**39**	121	36	86	279
19		20												10	25	56	26	39	133
20		4												2	8	11	5	18	41
21														1		1	5	5	18
22																	5		5
23																			1
Number of flowers	480	434	452	164	68	199	104	154	230	155	58	154	105	68	82	2748	620	975	4949

1) 16 flowers per plant. 2) 25 flowers per plant.

C. glauca the figures were 70—97 m.M. with an average of 87,1 from 435 measurements.

The staminodes of the F_1 were 70—89 m.M. long, mean 82,7, i. e. somewhat shorter than those of *glauca*. In comparison with *glauca* the extent of variation is limited which is no doubt explained by the fact that the F_1 consists of a single individual, whereas the flowers of 30 *indica* and 14 *glauca* plants were

TABLE XIX. LENGTH OF STAMINODES.

Species or hybrid	Number of flowers	Limits of variation in m.M.	Average	Standard deviation
C. indica	482	45—69	59,297	3,225
C. glauca	435	70—97	87,076	4,383
F_1	454	70—89	82,661	2,438
F_2, sowing 1	2752	57—95	76,346	6,467
F_2, sowing 3	620 [1])	57—97	76,732	7,097
F_2, sowing 4	975 [2])	56—100	77,277	8,206
F_2, total	4956	56—100	76,449	7,076

1) 10 flowers per plant. 2) 25 flowers per plant.

measured. (In this connection may be remembered the opposite conclusion for leaf length. The flowers however do not show an incomparability of dimensions dependent on their position on the floral axis.)

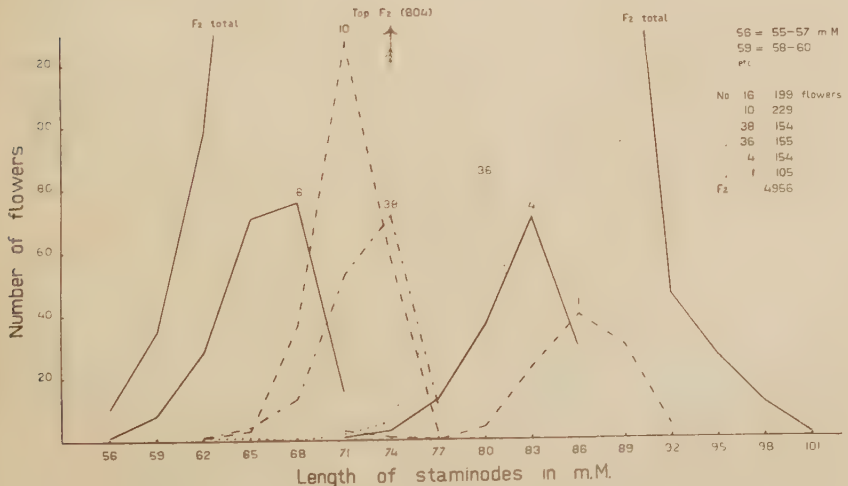

Fig. 8. Curve of staminode length of 6 F_2 plants with the lower end of the curve for F_2 total.

There is not much difference between the 1st, 3d and 4th sowing of the F_2, the averages being 76,3, 76,7 and 77,3 m.M., that is a little more than the midpoint of the parental means 73,2 m.M. The limits of variation are 57—95, 57—97 and 56—100 m.M. Only one specimen of the 4th sowing surpassed *glauca*.

The curve of staminode length of the F_2 as a whole is nearly regular though it shows a small increase where the F_1 has its top (table XVII, fig. 7).

TABLE XX. BREADTH OF STAMINODES.

Species or hybrid	Number of flowers	Limits of variation in m.M.	Average	Standard deviation
C. indica	480	8—14	10,808	0,962
C. glauca	434	13—20	16,235	1,334
F_1	452	14—18	16,524	0,696
F_2, sowing 1	2748	8—21	14,508	2,050
F_2, sowing 3	620 [1])	8—22	14,429	2,541
F_2, sowing 4	975 [2])	9—21	15,135	2,236
F_2, total	4949	8—23	14,637	2,240

1) 10 flowers per plant. 2) 25 flowers per plant.

In the same way as there could be selected plants with gradually increasing average length and breadth of the leaves, table XVII shows the curves of 8 F_2 plants with different average staminode length compared with those of *C. indica*, *glauca*, F_1 and F_2 (fig. 8). For staminode breadth table XVIII gives information about *indica*, *glauca*, F_1, F_2 and 12 separate F_2 plants. Whether all these 8 and 12 specimens are genotypically different is uncertain, even improbable. By the far more regular curves for each separate plant compared with the curves of leaf length, the chance of getting a reliable analysis of the factors for staminode length and breadth is much better.

The colour of the flowers.

The staminodes of *C. indica* are deep scarlet (plate I, fig. 1 and 2 is not deep enough), a trifle deeper of tint than scarlet no. 85 shade 4 of OBERTHÜR [1]), nearly red no. 26 of KLINCKSIECK and VALETTE [2]). Those of *glauca* are pale yellow, sulphur yellow

1) OBERTHÜR, R. Répertoire de couleurs, Société française des chrysanthémistes, 1905.

2) KLINCKSIECK, P. et TH. VALETTE. Code des couleurs, 1908.

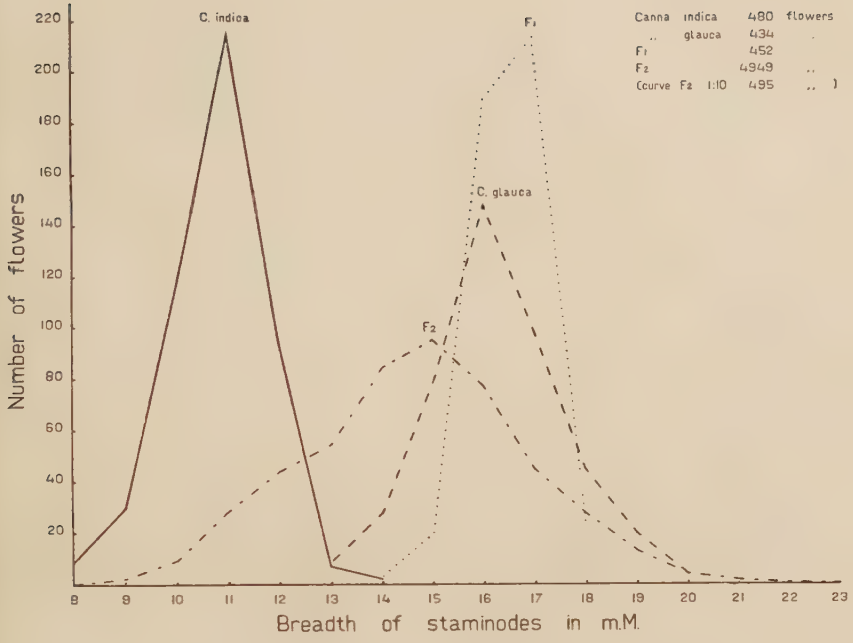

Fig. 9. Staminode breadth of *C. indica, glauca,* F_1 and F_2.

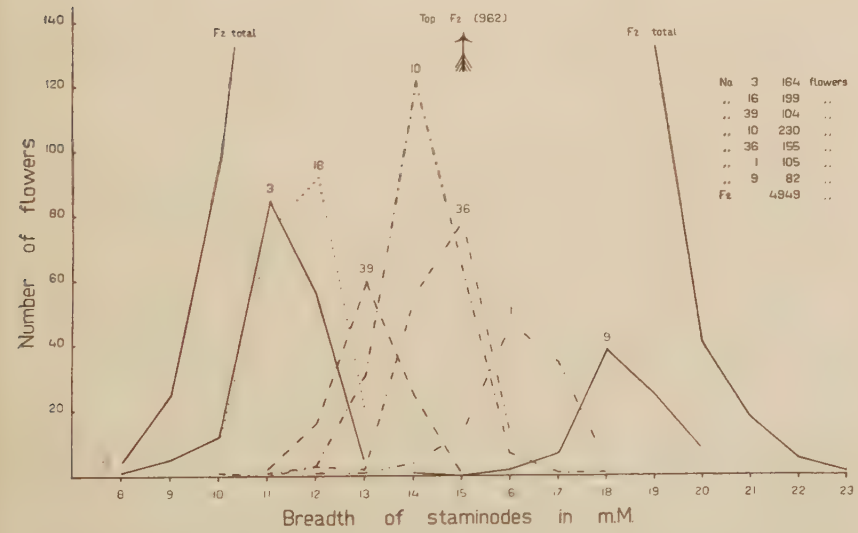

Fig. 10. Curve of staminode breadth of 7 F_2 plants with the lower end of the curve for total F_2.

no. 18—1 of Oberthür or between the nos. 216 and 221 of Klincksieck and Valette, and with some pink spots along the midveins (plate I, 4 and II, 5). These minute pink spots vary widely in number and dimensions from hardly visible for the naked eye to some millimeters. The yellow bleaches in course of the first blooming day.

TABLE XXI. SEGREGATION OF F_2 INTO PLANTS WITH RED AND WITH YELLOW FLOWERS.

Sowing	Number of plants				Ratios	
	total	leaves with red margin flowers	leaves green flowers		$a : b : c$	red : yellow
		a red	*b* red	*c* yellow		
1	64	34	15	15	2,27 : 1 : 1	3,27 : 1
2	33	22	5	6	3,67 : 0,83 : 1	4,50 : 1
3	140	76	19	45	1,69 : 0,42 : 1	2,11 : 1
4	49	24	10	15	1,60 : 0,67 : 1	2,27 : 1
5	178	108	18	52	2,08 : 0,35 : 1	2,42 : 1
6	127	79	23	25	3,16 : 0,92 : 1	4,08 : 1
7	81	49	18	14	3,50 : 1,29 : 1	4,79 : 1
Total	672	392	108	172	2,28 : 0,63 : 1	2,91 : 1
Theory	672	378	126	168	2,25 : 0,75 : 1	3 : 1

This pale yellow colour is no sap colour but limited to chromoplasts (plate IV*b*). The scarlet colour of *indica* is caused by a bluish red, carmin purple, cellsap turned into brillant deep scarlet by deep yellow chromatophores (plate IV*a*).

The flower of the F_1 is bright fiery red (plate I, 3).

With a view to the intensity of red in the flowers of the F_2 probably six different groups of tints can be distinguished, but partly under the influence of the different types of yellow, eleven shades of red were used for classification and some of these classes probably represent more than one genotype.

Among the yellow flowers there may be distinguished as groups pale yellow, yellow and deep yellow of which the yellow is present in one variable or perhaps in two shades (Oberthür 18—2 and 18—3) and the deep yellow as three shades of yolk yellow (Oberthür 24).

TABLE XXII. BACK CROSS OF F_1 BY C. GLAUCA. SEGREGATION INTO PLANTS WITH RED AND WITH YELLOW FLOWERS.

No.	Cross	Number of plants				Ratios	
		total	leaves with red margin flow. *a* red	leaves green flowers		*a* : *b* : *c*	red : yellow
				b red	*c* yellow		
361	$F_1 \times$ J4–2–3	7	4	1	2		2,50 : 1
365	$F_1 \times$ J4–2–3	36	8	2	26		0,38 : 1
370	$F_1 \times$ J4–2–3	2	1	1	–		
371	$F_1 \times$ J4–2–3	21	7	5	9		1,33 : 1
375	$F_1 \times$ J4–2–3	62	12	11	39		0,59 : 1
		128	32	20	76	0,42 : 0,26 : 1	0,68 : 1
363	J4–2–3 $\times F_1$	36	15	5	16		1,25 : 1
366	J4–2–3 $\times F_1$	25	8	5	12		1,08 : 1
368	J4–2–3 $\times F_1$	8	2	4	2		3,00 : 1
369	J4–2–3 $\times F_1$	33	11	11	11		2,00 : 1
372	J4–2–3 $\times F_1$	55	9	16	30		0,83 : 1
374	J4–2–3 $\times F_1$	21	6	5	10		0,91 : 1
376	J4–2–3 $\times F_1$	85	21	24	40		1,12 : 1
		263	72	70	121	0,60 : 0,58 : 1	1,18 : 1
364	J4–2–1 $\times F_1$	3	1	–	2		0,50 : 1
367	J4–2–1 $\times F_1$	18	3	5	10		0,80 : 1
373	J4–2–1 $\times F_1$	17	5	3	9		0,89 : 1
377	J4–2–1 $\times F_1$	3	–	1	2		0,50 : 1
		41	9	9	23	0,39 : 0,39 : 1	0,78 : 1
	Total	432	113	99	220	0,51 : 0,45 : 1	0,96 : 1
	Theory	432	108	108	216	0,50 : 0,50 : 1	1 : 1

The only means to get an idea of a factorial analysis consists in beginning with a treatment of the flower colours collectively as groups, in the first place reds and yellows. In the former it is easy to separate at once the plants with entirely green leaves from those with red margin that always have red flowers.

a. **The red colours.**

The ratios of plants with red and with yellow flowers in the F_2 are given in table XXI. For F_2 in total it does not differ very much from 3 : 1 and among the red flowered plants the ratios of plants with red leaf margin and those without is also nearly 3 : 1, but evidently there is a shortage of plants with green leaves and red flowers.

Neglecting the irregularities of the different sowings, the conclusion should be that one factor should decide whether a plant is to develop red or yellow flowers and that in the group of the red flowered plants those with red leaf margin have again one factor more than those with green leaves. Hence

TABLE XXIII. INTENSITY OF THE RED FLOWER COLOUR AFTER BACK CROSSING F_1 BY C. GLAUCA.

Back cross	Total number	Classes of red no.								uncertain.
		8	7	6	5	4	3	2	1	
J4–2–3 × F_1										
with red margin	72	4	**28**	15	11	4	7	1	1	1
with green leaves	69		2	4	**36**	9	9	6	3	
F_1 × J4–2–3										
with red margin	32		**20**	3	3	1	2	1		2
with green leaves	20			4	**12**	1	2	1		
J4–2–1 × F_1										
with red margin	9		**4**	2	–	–	3			
with green leaves	9			1	**5**	–	2	1		
Sum, with red margin	113	4	**52**	20	14	5	12	2	1	3
Sum, with green leaves	98		2	9	**53**	10	13	8	3	
Red margin transposed for the classes 8—3				4	**52**	20	14	5	12	

one of the factors for red leaf margin must be at the same time a factor for red flower colour or absolutely coupled with it.

The back cross of F_1 by *glauca* (table XXII) corroborates with the results of the F_2: one factor for red sap colour that

should be at the same time one of the factors for red leaf margin. And here also is a shortage of the type with red flowers and green leaves.

Numbering the shades of red hitherto observed in F_2, F_3, F_4, back crosses, etc., starting from the palest salmon pink as no. 1 and following the different tints to that of *indica* as no. 11, the back cross of F_1 by *glauca* ranges from no. 1 to no. 8 (the F_1 is red no. 7). The most numerous class of the plants with red leaf margin is bright fiery red class no. 7 and that for the plants with green leaves class 5 (table XXIII). The first impression is that the second factor for red leaf margin **B** acts as an intensification factor for the red flower colour **A**, but as there are among the plants with red leaf margin some specimens with shades of pale salmon pink reckoned to the classes 1 and 2, it is probable that a separate factor **E** showing a rather high degree of coupling with **B**, is responsible. This however remains uncertain as the same result may be reached when **B** should act as intensification factor only in the presence of one of the other intensification factors.

Class 5 is exactly the type of flower colour after the cross *glauca* × F_3 10—3 (plate II. 4) of which 232 seedlings have been planted and nearly 200 bloomed, all uniform in flower colour, coral red Oberthür 76—1 or rosy scarlet Oberthür 90—3 on the margin and 76—2 along the midveins (Klincksieck and Valette no. 66 in the middle and somewhat paler towards the margin). Next day after opening the colour is less brillant by bleaching of the yellow and looks more like salmon pink Oberthür 126. There was only one exception, a plant with flowers noticeably deeper of tint, coral red 76—2 at the staminode margin (plate II, 3).

In this cross *glauca* was used as ovule plant as it yields considerably more seeds than $F_3/10-3$ by producing more stalks and often more seeds per fruit.

Of $F_3/10-3$ a F_4 has been raised of 90 seedlings of which 66 bloomed, all like the parentplant (plate II, 1 and 2). Of *glauca* I got ± 150 specimens flowering and all were similar. As the ± 200 blooming plants of *glauca* × $F_3/10-3$ were uniform with the exception of one plant with a somewhat deeper tint of red, but without yellow specimens or paler reds, there is a chance that $F_3/10-3$ was homozygous for flower colour as well as *glauca*.

The back crosses *glauca* × (*glauca* × $F_3/10-3$) and (*glauca* × $F_3/10-3$) × *glauca* — (considering $F_3/10-3$ as a type and not as a descendant of a *glauca*-hybrid we might speak, as De Vries does, of iterative and sesquireciprocal crosses) - -

yielded a nearly equal number of red and yellow flowered plants. 123 and 132. The surplus of yellows is in cross 384 (table XXIV) where the pollen plant is red.

The type of heredity of the red flower colour of $F_3/10—3$ (class 9 to 10) is the *Zea*-type (plate II, fig. 1, 2, 4, 5), J4—2—3 × $F_3/10—3$ belongs to class 5. Back crossing by *glauca* for a second time does not originate once more an intermediate type of reds, but, apart from the yellows, five classes of reds of which the highest with the deepest tints is the most numerous.

TABLE XXIV. SEGREGATION FOR FLOWER COLOUR AFTER BACK CROSSING FOR A SECOND TIME $F_3/10$–3 BY C. GLAUCA.

No.	Cross	Number of plants	Flower colour red, class nr.						yellow
			5	4	3	2	1	total	
384	J4–2–3 × (J4–2–3 × $F_3/10$–3, nr. 354–3)	175	57	3	11	6	3	80	95
389	J4–2–1 × (J4–2–3 × $F_3/10$–3, nr. 354–3)	4	3	–	–	–	–	3	1
386	(J4–2–3 × $F_3/10$–3, nr. 354–2) × J4–2–3	14	4	2	–	–	–	6	8
387	(J4–2–3 × $F_3/10$–3, nr. 354–10) × J4–2–3	54	17	6	2	3	–	28	26
388	(J4–2–3 × $F_3/10$–3, nr. 354–3) × J4–2–3	3	1	–	–	–	1	2	1
390	(J4–2–3 × $F_3/10$–3, nr. 353–7) × J4–2–3	5	3	1	–	–	–	4	1
	Total	255	85	12	13	9	4	123	132

Probably an explanation could be given by assuming that the hybrid *glauca* × $F_3/10—3$ contains the factor for red flower colour **A** and an intensification factor **D**. When one wishes to ascribe some significance to the figures of cross 384 in table XXIV, the most numerous of all, it is possible to detect some regularity by adding the classes 5 and 4 (in fact very approaching) and the classes 3, 2 and 1. The ratio 60 : 20 or 3 : 1 for the deeper and paler reds is only possible when the *glauca* J4—2—3 and the hybrid J4—2—3 × $F_3/10—3$ both are heterozygous for the intensification factor **D**, hence no.384 should be **aaDd** × **AaDd**.... and the result the phaenotypes 3 **AD**, 1 **Ad**, 3 **aD** and 1 **ad**. Of course the constancy of $F_3/10—3$ after selfing has no importance here and the constancy of J4—2—3 after

selfpollination does not necessarily produce difficulties. When the factor **D** has no influence upon the pink spots of *glauca* it does not matter for the constancy of the type whether *glauca* possesses **D** or not, and if the intensity of the spots does depend on **D** and consequently *glauca* must be constantly heterozygous, the case would not be an isolated one; the homozygous form may perish, a phenomenon already known from yellow mice [1]), *Oenothera* [2]) and *Drosophila* [3]).

TABLE XXV. SEGREGATION FOR FLOWER COLOUR OF (J4–2–3 × F_3/10–3) AFTER SELFING.

Nr.	Plant selfed	Number of offspring	Flower colour								
			red, class nr.								yellow
			8	7	6	5	4	3	2	1	total
391	J4–2–3 × F_3/10–3. nr. 353–7	44		5	8	**13**	5	1			32	12
392	J4–2–3 × F_3/10–3, nr. 354–2	40	2	–	5	**15**	1	2	–	1	26	14
395	J4–2–3 × F_3/10–3, nr. 354–8	44		4	4	**17**	–	2	–	1	28	16
396	J4–2–3 × F_3/10–3, nr. 354–9	8			1	–	–	2	–	1	4	4
397	J4–2–3 × F_3/10–3,nr.354–10	24	1	3	2	**7**	3	–	1		17	7
	Total	160	3	12	20	**52**	9	7	1	3	107	53

Some support is afforded to such an additional hypothesis by the results of selfing J4—2—3 × F_3/10—3. In stead of finding the 3 : 1 ratio expected for red and yellow the ratio is 107 : 53 or 2 : 1 (table XXV). There were 119 seedlings more planted out, children of selfed sisterplants, but they did not bloom when I left Medan. For this 2 : 1 ratio it does not matter whether homozygosis of the factor for red colour **A** or the intensification factor **D** acts killing or of **A** and **D** both separate and together. In the first and second case there remain 8 reds and 4 yellows out of 16 and in the third 6 reds and 3 yellows. What decides in the three possibilities, are the ratios of types of red of different intensities. No. 384 with 3 coral reds : 1 salmon

1) Castle, W. E. and C. C. Little. On a modified mendelian ratio among yellow mice. Science N. S. XXXII, p. 768, 1910.

2) Heribert Nilsson, N. Die Spaltungserscheinungen der Oenothera Lamarckiana, Lunds Univ. Arsskrift N. F. Avd. 2, Bd. 12, S, 27, 1915.

3) Muller, H. J. An Oenothera like case in Drosophila. Proc. of the nat. Acad. of Sciences 3, p. 619, 1917.

pink should suggest that the intensification factor **D** may be present without injurious effect.

The F_3 after selfing F_2/no. 30 proves however that the factor for red colour **A** also may exist homozygous. The F_3 consisted of 23 plants with red flowers and red leaf margin, 11 with red flowers and green leaves and 9 with yellow flowers, nearly 2 : 1 : 1 and more than three times as many red flowered plants as yellows. If the **AA** forms perished and the **BB** were left alive, the ratio per 16 should be 6 : 2 : 4, i. e. twice as many yellows as reds with green leaves. When however the second red leaf margin factor **B**, if homozygous, kills its bearer, the ratio will be 6 : 3 : 3 or 2 : 1 : 1.

But this factor **B** is absent in the F_3/10—3 back crosses spoken of above, hence either **A** and **D** together are homozygously impossible, or there exists another factor Q lethal if homozygous (and here lethal factor is as usual another expression for something I do not know).

The results of the two least small back crosses reciprocal to no. 384, the nos. 386 and 387, chime fairly well with the scheme. There are 34 reds and 34 yellows, the ratio coral red : salmon pink is 29 : 5 in stead of 25,5 : 8,5 and selfing these two motherplants of the back cross yielded 43 reds : 21 yellows, just 2 : 1.

Apart from the 2 : 1 ratio after selfing (J4—2—3 × F_3/10—3) there is one argument more to consider all reds as heterozygous for at least one of the factors: among the 107 reds not a single one reached the claret (Oberthür 167 shade 3—4, Klincksieck and Valette ± 6) of F_3/10—3, class 9 to 10.

Whether the figures are reliable may be uncertain, but it is a fact that the palest group, class 3—1 of J4—2—3 × F_1 is for the plants with red leaf margin exactly one eighth of the total number, 9 out of 72, and for the plants with green leaves one fourth, 18 out of 69 (table XXIII). The same thing is to be seen for the sum of all plants with red margin when the former series is combined with those of the reciprocal back cross and that by J4—2—1, viz. 15 out of 113, and the sum of the greens 24 out of 98. This indicates a third intensification factor **F**, present in F_1 but also in F_3/10—3, which lacks **B**, eventually also **E**. The deep tint of F_3/10—3 moreover requires more than the factor **D** only.

b. **The yellow colours.**

Although the brightness of the red colours is influenced by the presence of the yellow ones, the latter are hypostatically covered by the former.

As never a white flowered plant arose,[1] both *glauca* and *indica* will contain the pale yellow that in *indica* is turned into (or covered by?) deep yellow by two factors **H** and **I**. This follows from the segregation in the progeny of the deep yellow plant F_2 no. 75 which broke up in F_3 in close approximation to the 9 : 3 : 4 ratio, viz. 38 deep yellow, 14 yellow and 16 pale yellow (expectation $38\frac{1}{4}$: $12\frac{3}{4}$: 17, table XXXVI).

As for so many characteristics already discussed the figures of F_2 are not in accordance with this assumption. Instead of finding a majority of deep yellows among all non-reds there were 23 only out of 172 or 1 : 6.48; and at the same time the proportion is variable (table XXVI). The shortage of deep yellows among the non-reds is a consequence of the surplus of plants with deep yellow chromatophores among the red flowering ones. I confess that a small part only has been controlled with the microscope, but the reds without the brightness caused by the deep yellow were proportionally rare among the deep reds from the tint of the F_1 to deeper (class 7—11), viz. 24, while in class 6 only one was found. In the lower classes as a rule **H** and **I** are absent. In consequence both factors **H** and **I are coupled to the intensifiers for red.**

TABLE XXVI. DIFFERENT TINTS OF YELLOW IN F_2.

Sowing	deep yellow	yellow	pale yellow	total	deep y. : (y. + pale y.)
1	1	12	2	15	1 : 14
2	2	1	3	6	1 : 2
3	6	19	20	45	1 : 6,5
4	—	7	8	15	
5	8	33	11	52	1 : 5,5
6	4	21	—	25	1 : 5,25
7	2	12	—	14	1 : 6
Total	23	105	44	172	1 : 6,48

The difference between the deep yellows and the others is rather sharp but that between yellow and pale yellow is not so distinctly marked in all cases, probably owing to small differences between plants homozygous and heterozygous for one of the factors **H** and **I**. As most yellow flowered plants are

[1] [illegible], l. c. S. 7: Reinweisse Canna zu erzielen ist bei langjähriger verlockenden Anfängen, noch immer der unerfüllte Wunsch der Züchter geblieben.

not very fertile after self pollination it will take some time to make it clear.

Also the deep yellows are by no means exactly the same. F_3/no. 75 contained among the 38 deep yellows 3 exceedingly deep coloured specimens (theory : $4\frac{1}{2}$), of the same deep shade as appeared for instance partly in the descendants of the red leaf margined plant F_2/no. 1 after selfing.

The results of the back crosses of F_1 by *glauca* are in full agreement with those mentioned above. The factors **H** and **I** demonstrating themselves in F_3/ no. 75 as dominants, appeared together among the yellow flowered offspring of the back cross only 5 times out of 220, all 5 no doubt heterozygous for **H** and **I**, the intensity of the deep yellow being that of F_2/no. 75 (plate III. 1) and certainly not the much deeper shade of the 3 specimens of F_3/75 (plate III, 4) and of those F_3/no. 1 individuals. Distinctly yellow were 81, pale yellow 63, the remaining 71 specimens probably partly yellow, for a large part pale yellow or intermediate. Classification of these plants would not have been possible for me without inducing the feeling of making mistakes.

Among the 53 yellows gained after selfing (J4—2—3 × F_3/10—3) individuals, there appeared not a single deep yellow specimen, no more among the 132 yellows of the second back cross of F_3/10—3 by *glauca* (tables XXV and XXIV).

c. **Flaking.**

The staminodes of *C. indica* are plain red, those of *glauca* pale yellow with minute pink spots along the middle veins. Among the F_2 apart from the intensity of the red colours and the size of the spots one may discern four types of flaking:

1. a central red part over half the staminode breadth or more with small spurs along the veins in a somewhat paler red border;

2. a central red colouring in a yellow border (like the *Canna* variety *Königin Charlotte*);

3. red spots along the middle of the yellow staminodes like those of *C. glauca*;

4. red spots spread over the whole breadth of the yellow staminode, especially at the top (like the variety *J. B. van der Schoot*).

1. **The deeper vein colouring** is rather easily distinguishable in the pale red types but more difficultly in the deeper reds, is even not always clearly visible in the F_1. Hence it was not accidental that after back crossing F_1 by *glauca*, which pro-

duces paler red tints, the number of plants with noticeably deeper colour in the middle of the staminodes was proportionally much higher than after selfing the F_1, viz. 161 out of 199 as against 56 out of 500 (tables XXVII and XXVIII). Probably we had better speak of at least 56.

There is in the ratio 161 : 38 in the back cross of F_1 by *glauca* a surplus of dominants and *glauca* and F_1 both should have been heterozygous for the vein colouring factor **J**.

TABLE XXVII. PLANTS WITH RED STAMINODES OF DEEPER SHADE ALONG THE VEINS AFTER BACK CROSSING F_1 AND C. GLAUCA.

Back cross	With red leaf margin			With green leaves		
	number of plants	veins deeper tinged; staminode margin		number of plants	veins deeper tinged; staminode margin	
		red	yellow		red	yellow
$F_1 \times$ J4—2—3	32	28	1 [1])	20	12	1 [2])
J4—2—3 $\times F_1$	72	52	4 [3])	70	54	5 [4])
J4—2—1 $\times F_1$	9	8	1 [5])	9	7	1 [6])
Total	113	88	6	99	73	7

1) With narrow yellow margin.
2) With narrow yellow margin.
3) With broad yellow margin 2, with narrow 2.
4) With broad yellow margin 2, with narrow 3.
5) With broad yellow margin.
6) With narrow yellow margin.

About the back cross J4 —2—3 $\times$ F_3/10 —3 I have no figures. The second back cross J4 —2—3 $\times$ (J4—2—3 $\times$ F_3/10 —3) or reciprocal proved that all plants chosen as ovule plants (perhaps with the exception of no. 388) were heterozygous for **J**, just like *glauca* (table XXIX). As the number of plants with deeper vein colouring is nearly three quarters of the total number, viz. 95 out of 123, the results of this second back cross should be in accordance with those of the back cross of F_1 if not 5 specimens remained uncertain and even 9 (of which 8 of one no.) were variable, changing the appearance of the flowers on one and the same plant. The latter peculiar phenomenon occurred once more after selfing (J4—2—3 $\times$ F_3/10—3) plants. Then

TABLE XXVIII. F_2 PLANTS WITH RED STAMINODES OF DEEPER SHADE ALONG THE VEINS.

Sowing	With red leaf margin			With green leaves		
	number of plants	veins deeper tinged staminode margin		number of plants	veins deeper tinged staminode margin	
		red	yellow		red	yellow
1	34	–	1	15	–	2
2	22	2	–	5	1	–
3	76	4	1	19	–	–
4	24	3	–	10	1	1
5	108	11	1	18	1	1
6	79	9	1 [1)]	23	5	–
7	49	16	–	18	3	1 [1)]
Total	392	45	4	108	11	5

1) Yellow margin narrow.

17 were uncertain and 1 variable. The rest however showed the clean cut 3 : 1 ratio (67 : 22). The 5 and 17 uncertain and the 9 and 1 variable specimens make the 14 and 22 plain uncertain also. They might have been extreme variates of the variable group, perhaps the 3 : 1 ratio occurred through the merest

TABLE XXIX. SEGREGATION OF RED FLOWERING PLANTS FOR DEEPER COLOUR ALONG THE STAMINODE VEINS AFTER BACK CROSSING FOR A SECOND TIME F_3/10–3 BY C. GLAUCA.

No.	Cross	Number of plants	deeper tinged along the veins	plain	uncertain	variable
384	J4–2–3 × (J4–2–3 × F_3/10–3, no. 354–3)	80	69	9	2	–
389	J4–2–1 × (J4–2–3 × F_3/10–3, no. 354–3)	3	2	1	–	–
386	(J4–2–3 × F_3/10–3, no. 354–2) × J4–2–3	6	5	1	–	–
387	(J4–2–3 × F_3/10–3,nr.354–10) × J4–2–3	28	15	2	3	8
388	(J4–2–3 × F_3/10–3, no. 354–3) × J4–2–3	2	2	–	–	–
390	(J4–2–3 × F_3/10–3, no. 353–7) × J4–2–3	4	2	1	–	1
	Total	123	95	14	5	9

chance. Two polymeric factors each of which individually is very unstable in its demonstration, are also possible.

2. **Central red colouring in a yellow border** occurred in F_2 4 times on plants with red leaf margin and 5 times on plants with green leaves (table XXVIII). The back cross of F_1 by *glauca* produced 6 resp. 7 specimens (table XXVII).

A typical yellow bordered specimen with red leaf margin F_2/no. 37 was selfed. The F_3 consisted of 11 plants, 8 with red leaf margin and 3 with green leaves, of which 10 bloomed, all with red middle part and yellow border. There were selfed anew one with red leaf margin and one with green leaves. The former $F_3/37$—1 produced a F_4 of 45, viz. 33 with red leaf edges and 12 greens, of which 26 flowered. The latter $F_3/37$ 2 yielded a F_4 of 9 of which 8 bloomed like the parentplant. Whereas the green leaved $F_3/37$—2 bred true in F_4 with rather broad yellow margin, the $F_4/37$—1 did not do so, the yellow margin varying from very broad to nearly absent, broad in all green leaved specimens and also broad in 13 out of the 18 with red leaf margin and 5 with narrow or very narrow yellow border.

TABLE XXX. SEGREGATION OF RED FLOWERING PLANTS FOR DEEPER VEIN-COLOURING AFTER SELFING (J4–2–3 × F_3/10–3).

No.	Hybrid, selfed	Number of plants	deeper vein colouring	plain	uncertain	variable
391	J4–2–3 × F_3/10–3, no. 353–7	32	19	7	5	1
392	J4–2–3 × F_3/10–3, no. 354–2	26	18	7	1	–
395	J4–4–3 × F_3/10–3, no. 354–8	28	19	4	5	–
396	J4–2–3 × F_3/10–3, no. 354–9	4	2	2	–	–
397	J4–2–3 × F_3/10–3, no.354–10	17	9	2	6	–
	Total	107	67	22	17	1

The back cross of the same $F_3/37$ 1 plant by *glauca* (the latter as ovule plant) produced the same results as regards the variability of breadth of the yellow margin. Of the 17 children with red leaf margin 14 bloomed, of the 18 with green leaves 17, together 31 of which 23, i. e. three quarters, showed a narrow or very narrow yellow margin and 8 a broad one. The colouring of almost the entire staminode must be dominant to the slighter extension of the red colour. However the distribution of both types is not proportional to the almost equal numbers of plants

with red leaf margin and those without, as the latter contained 7 out of the 8 specimens of the recessive type, whereas only one of the 14 red leaf margin plants was with broad yellow margin, which indicates coupling of the extension factor **P** with **B**, the second factor for red leaf margin. Of course it is possible to explain the 3 : 1 ratio assuming that *glauca* and $F_3/37$—1 are both heterozygous for the factor **P**. But the results of selfing $F_3/37$—1 with 5 specimens with narrow yellow margin out of 26 would contradict the supposition; here again there is a surplus of recessives.

That the same factor **J** is responsible for the central colouring in entirely red and in yellow marginated flowers is not certain, as **J**, in whole coloured red types, partially prohibits the action of an intensification factor and in $F_2/37$ and its offspring it would suppress in the margin the colour factor **A** itself.

The F_5 perished totally owing to a *Rhizoctonia* pest in my cultures at Wageningen and now I must wait for the results of the back cross by *C. indica* that is supposed to be recessive for **J**. Back crossing by pure yellow was impossible, as in 1922 not a single one of the F_2 or other yellows was pure yellow.

3. **Red spots along the middle of the yellow staminode.** The localisation of the red colours is nearly the same as the region influenced by the factor **J**, but often narrower, and the anthocyanin extension is limited to insular splashes in the yellow. While group 2 is counted as red the groups 3 and 4 are reckoned as yellow for practical purposes. It is however still possible

TABLE XXXI. SPREAD OF RED SPOTS ON YELLOW FLOWERS IN F_2.

Sowing	Extension of the red spots						Total
	spread over whole breadth		confined to the middle of the staminodes				
			stronger than with glauca	nearly like glauca	weaker than with glauca	absent	
	number	%					
1	–	0	6	6	–[1])	3	15
2	–	0	–	6	–[1])	–	6
3	–	0	23	16	–[1])	6	45
4	1	7,1	3	8	1	1	14
5	2	3,8	15	16	8	11	52
6	6	24,0	4	4	5	6	25
7	8	57,1	2	–	2	2	14
Total	17	9,9	53	56	16	29	171
				72			

1) In the first sowings not distinguished from the preceding column.

that the colour factor **A** with or without one or more of the intensifiers is also present in the groups 3 and 4, manifesting themselves in the different shades of red of the spots, so that another factor than **A** might decide between red and yellow, and that the factor **R** effects the patching only and not the colour.

Among the 171 studied yellow flowering F_2 plant there were 29 specimens without any red in the staminodes. This wholly yellow type is the weak point in the analysis as it occurred more than once that a plant noticed for pure yellow after some weeks or months showed very small red points. Whilst in the three first sowings of F_2 the difference between *glauca* and the specimens with still less development of anthocyanin, i. e. the group „weaker than *glauca*", was neglected on account of the rather considerable variability of *glauca* itself, later on it was evident that the groups „weaker than *glauca*" and „absent" (table XXXI) could not always be separated correctly. The back cross of F_1 by *glauca* produced nearly half the number of yellows with the *glauca*-like type of patching, 115 out of 220 yellows (table XXXII).

TABLE XXXII. SPREAD OF THE RED SPOTS IN THE YELLOW OFFSPRING OF THE BACK CROSSES OF F_1 BY C. GLAUCA.

Back cross	Extension of the red spots				absent?	Total
	over the whole breadth	confined to the middle of the staminode				
		stronger than glauca	nearly like glauca	weaker than glauca		
$F_1 \times$ J4–2–3	20	–	26	7	23	76
J4–2–3 $\times F_1$	26	4	47	15	29	121
J4–2–1 $\times F_1$	6	1	13	2	1	23
	52	5	86	24	53	220
			115			
Expectation	55		110		55	220

4. **Red spots spread over the whole surface of the staminode** was for the first time seen in the fourth sowing of F_2. As the 1st and 3d sowing were also used for measuring length and qreadth of staminodes at the same time as the fourth and the

type is strikingly different from *glauca* it could not have been overlooked when it had occurred. Failing in the 66 yellow specimens of the 1st — 3d sowing, it appeared 3 times among the 66 yellows of the 4th -5th sowing, 6 times among the 25 yellows of sowing 6 and even 8 times out of 14 in the 7th sowing. This is indeed one of the most striking cases of variability of segregation.

The back cross F_1 by *glauca* produced the wholly speckled type 52 times out of 220 yellows, that is 23,6 %.

The whole-spotted type seems to be homozygous, as all 15 flowering F_4 plants gained after selfing the whole-spotted F_3/10 -2 were spotted over the whole breadth, varying in intensity of the red and considerably in the number of spots (plate VII).

Another selfed specimen, a F_3 of F_2/no. 1 with large fiery red spots on deep yellow was sterile. This plant proved that the factor for patching was hypostatically covered in the red flowered plant F_2/no.1 of the first sowing where the whole-spotted type phaenotypically fails.

The result of the back cross of F_1 by *glauca* (table XXXII) wholly spotted: *glauca*-like: pure yellow as 52 : 115 : 53 or 0,95 : 2,09 : 0,96 leads to the expectation that the whole-spotted type is homozygous and the *glauca*-like type heterozygous for a factor **R** and that *glauca* itself is a constant heterozygote for this factor.

The ratio 2 reds : 1 patched yellow : 1 pure yellow after crossing back (J4—2—3 × F_3/10—3) by *glauca* (tables XXIV and XXXIII) may be brought in accordance with this idea on condition that in (J4—2—3 × F_3/10—3) **R** be almost absolutely coupled with **A**, so that it forms chiefly **AR** and **ar** and occasionally also a few **Ar** and **aR** gametes. Then the result is **AaRR** + **AaRr** + **aaRr** + **aarr** or 2 reds (heterozygous for **A**): 1 *glauca* type: 1 pure yellow, whilst the small amount of wholly spotted yellows **aaRR**, 3 out of 129, should have arisen by meeting of two **aR** gametes, of which that of the hybrid should have been originated by crossing-over.

If that be true, one may expect that in case of selfing (J4—2 —3 × F_3/10 —3) should produce mainly 1 **AARR** (killed): 2 **AaRr** : 1 **aarr**, i. e. reds and pure yellows only and exceptionally some patched yellows. In fact however, only half of the yellows are pure, 28 out of 53, and the number of **aaRR** is increased, 4 out of 53 in stead of 3 out of 129. Hence the % of crossing-over is much higher (free Mendelian segregation, or 50 % crossing-over would have produced, omitting the **AA** forms, 8 reds : 1

TABLE XXXIII. SPREAD OF THE RED SPOTS IN THE YELLOW FLOWERING PROGENY OF THE BACK CROSS OF F_3/10–3 BY C. GLAUCA.

No.	Second back cross by glauca or selfing (glauca × F_3/10—3)	Extension of the red spots					Total.
		over the whole breadth	confined to the middle of the staminode			absent?	
			stronger than glauca	nearly like glauca	weaker than glauca		
384	J4–2–3 × (J4–2–3 × F_3/10–3, nr. 354–3)	2	3	28	13	47	93
389	J4–2–1 × (J4–2–3 × F_3/10–3, nr. 354–3)	1	–	–	–	–	1
386	(J4–2–3 × F_3/10–3, nr. 354–2) × J4–2–3	–	–	3	1	4	8
387	(J4–2–3 × F_3/10–3, nr. 354–10) × J4-2-3	–	–	6	6	13	25
388	(J4–2–3 × F_3/10–3, nr. 354–3) × J4–2–3	–	–	–	–	1	1
390	(J4–2–3 × F_3/10–3, nr. 353–7) × J4–2–3	–	–	–	1	–	1
	Total	3	3	37	21	65	129
391	(J4–2–3 × F_3/10–3, nr. 353–7) selfed	2	–	2	3	5	12
392	(J4–2–3 × F_3/10–3, nr. 354–2) selfed	1	–	3	4	6	14
395	(J4–2–3 × F_3/10–3, nr. 354–8) selfed	1	–	3	4	8	16
396	(J4–2–3 × F_3/10–3, nr. 354–9) selfed	–	1	–	–	3	4
397	(J4–2–3 × F_3/10–3, nr. 354–10) selfed	–	–	–	1	6	7
	Total	4	1	8	12	28	53

wholly spotted : 2 *glauca*-like : 1 pure yellow). The real figures 107 : 4 : 21 : 28 are very nearly approached on assuming a cross-over value of 27,4 % or the gametic ratios 2,65 **AR** : 1 **Ar** : 1 **aR** : 2,65 **ar**, viz. 106,6 : 4 : 21,2 : 28,1, indeed a splendid harmony, too fine to be true. But, although with the crossing-over hypothesis almost every ratio can be „explained", it gives no explanation for the difference in behaviour of (J4—2—3 × F_3/10—3) that in a back cross by *glauca* should have shown less than 3 % cross-overs and in case of selfing about 27 %. A factor in *glauca* which lowers the amount of crossing over?

There has not been made a trial for explanation on a base of dissimilarity of pollen and ovule gametes, as both reciprocal crosses of (J4—2—3 × F_3/10—3) by *glauca* yielded the same results as regards the number of pure yellows in the total yellow flowered offspring (table XXXIII): 47 is as well the half of 93 (no. 384) as 4 is the half of 8 and 13 of 25 (nos. 386 and 387).

It is not certain that all (J4—2—3 × F_3/10—3) specimens will be **Rr** plants as the most fertile ones proved to be.

F_2/no. 1 was rather deep red (class 9) and the red flowered F_3 were at least fiery red as F_1, but most of them deeper. The patches of the deep yellow F_3 specimens were fiery red in stead of pink as in *glauca*. Hence it is clear that the intensifiers for **A** are at the same time intensification factors for **R**.

Coupling of insufficiently known factors.

1. „Coupling" of the factors for the numbers of staminodes and those for colour. Whereas in F_2 the ratio of red flowered plants with red leaf margin: red flowered plants with green leaves: yellow flowered ones is 2,28 : 0,63 : 1 (i. e. the 9 : 3 : 4 ratio with a shortage in the second group of 16 %, the ratio for the same types among the plants with two and two to three staminodes is as 23 : 3 : 21 or 1,10 : 0,14 : 1 (table XXXIV). Relatively the number of plants with 2 staminodes and yellow flower colour is very high. This is the more remarkable as the parent with two staminodes has not yellow but red flowers so that coupling of the factors for red with 3 and for yellow with

TABLE XXXIV. THE PROPORTIONALLY LARGE NUMBER OF PLANTS WITH YELLOW FLOWERS HAVING 2 OR 2—3 STAMINODES.

Sowing	Number of plants				Three to two staminodes			Two staminodes			Ratio red : yellow
	total	leaves with red margin flowers a) red	leaves green flowers b) red	c) yellow	a)	b)	c)	a)	b)	c)	
1	64	34	15	15	1	–	–	–	–	1	1 : 1
2	33	22	5	6	1	–	1	–	–	–	1 : 1
3	140	76	19	45	2	–	4	–	–	–	2 : 4
4	49	24	10	15	1	–	3	–	–	1	1 : 4
5	178	108	18	52	5	1	3	2	–	2	8 : 5
6	127	79	23	25	6	2	2	1	–	–	9 : 2
7	81	49	18	14	3	–	3	1	–	1	4 : 4
	672	392	108	172	19	3	16	4	0	5	26 : 21
		500									

Ratio red : yellow for all flowers 2,91 : 1; and for the plants with 2 and 2–3 staminodes 1,24 : 1.

TABLE XXXV. RELATION BETWEEN LENGTH OF STAMINODES AND COLOUR OF LEAVES AND STAMINODES

Average length in mM.	Second generation			total	F_1 × J 4-2-3			J 4-2-3 × F_1			J 4-2-1 × F_1			Back cross F_1 and C. glauca, totals			total
	red margin flowers red	leaves green: flowers red	leaves green: flowers yellow		red margin flowers red	leaves green: flowers red	leaves green: flowers yellow	red margin flowers red	leaves green: flowers red	leaves green: flowers yellow	red margin flowers red	leaves green: flowers red	leaves green: flowers yellow	red margin flowers red	leaves green: flowers red	leaves green: flowers yellow	
< 62										1						1	1
62–63		1	1	2						–						–	–
64–65		–	–	–						–						–	–
66–67	3	2	6	11						–						–	–
68–69	2	2	1	5						1						1	1
70–71	2	5	–	7				1	3	–				1	3	–	4
72–73	**10**	**7**	2	**19**			1	–	3	1				–	3	2	5
74–75	**13**	3	3	**19**		2	4	–	–	1			1	–	2	6	8
76–77	12	2	6	**20**	1	1	4	–	3	3		1	–	1	5	7	13
78–79	7	3	4	14	1	2	5	4	8	5		–	1	5	10	11	26
80–81	5	3	6	14	–	3	9	4	**14**	10		2	1	4	**19**	20	43
82–83	5	1	5	11	2	1	8	5	12	15	1	**3**	–	8	16	23	47
84–85	**11**	2	2	**15**	4	**6**	**15**	5	**13**	11	–	1	**7**	9	**20**	33	**62**
86–87	7	2	3	12	**6**	1	10	10	4	**27**	2		4	**18**	5	**41**	**64**
88–89	1	–	2	3	**6**	1	10	6	2	14	–		3	12	3	27	42
90–91	1	–	–	1	4		4	10	1	9	**3**		2	**17**	1	15	33
92–93		1	–	1	4		2	**13**	1	4	1		1	**18**	1	7	26
94–95		1	–	1	1		2	4	1	4	1		2	6	1	8	15
96–97			1	1			1	2		4	1			3		5	8
98–99								3		2				3		2	5
100–101								1						1			1
Number of plants	79	35	42	156	29	17	75	68	65	112	9	7	22	106	89	209	404

2 staminodes would not be expected. Difference in velocity of growth of pollen tubes?

2. „Coupling" of **B** with factors for staminode length. As well in F_2 as in the back crosses of F_1 by *glauca*, but most clearly in the back crosses, the red flowered plants with green leaves (**AAbb** or **Aabb**) have on an average shorter staminodes than those with red leaf margin (with **B**) and also shorter than the yellow ones (partly **BB** or **Bb**, partly **bb**). As **B** is a factor present in *indica* and not in *glauca* and long staminodes are a characteristic of *glauca* there should be, just as in the former case, more than 50 % cross-overs (unless the distribution of

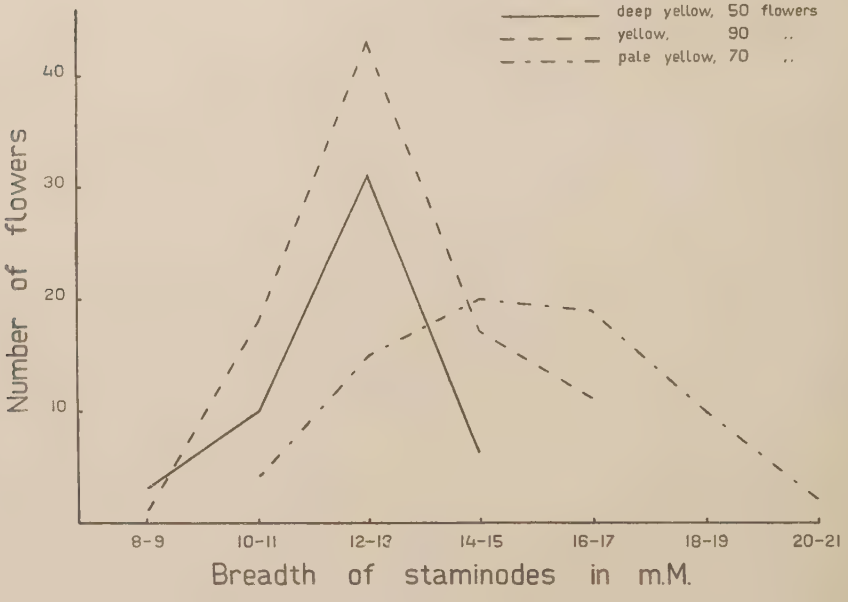

Fig. 11. Deep yellow staminodes are in F_2 as a rule narrower than pale yellow ones.

chromosomes be not a random one in the reduction division).

3. Repulsion of the factors for deep yellow chromatophores and those for staminode breadth. As a rule the deep yellow staminodes are narrower than the pale yellow ones just as the parent with the deep yellow chromatophores *indica* is narrower than the pale yellow *glauca* with broad staminodes. In contrast with the two former sets of characters, there exists here a tendency of keeping together those factors that are inherited from one parent. When however a type is homozygous for staminode breadth as F_2/no.75 seems to be, there is in the follow-

TABLE XXXVI. RELATION BETWEEN BREADTH AND COLOUR OF STAMINODES.

Breadth in mM.	F_2 2d sowing, yellow flowers [1])			F_3/75 (F_2/no. 75 was deep yellow) average breadth of plants with flower colour			
	deep y.	yellow	pale y.	deep y.	yellow	pale y.	total
8–9	3	1		4			4
10–11	10	18	4	6	4	3	13
12–13	**31**	**43**	15	**19**	**7**	**9**	**35**
14–15	6	17	**20**	9	1	4	14
16–17		11	**19**		2		2
18–19			10				
20–21			2				
Number of flowers	50	90	70	38	14	16	68 plants
				38,25	12,75	17	expectation

1) Ten flowers per plant.

ing generation no difference in average breadth between the deep yellow, yellow and pale yellow flowers (table XXXVI and fig. 11).

About the seeds it has already been mentioned that the seed coat of F_1, in the tropics, is more uniformly black than it sometimes is in Holland. The seeds of *glauca* and yellow flowered hybrids, at Medan, were in their speckledness rather variable (often even on one and the same plant) so that I do not trust my figures before I have been able to control them with more homozygous material. And so it is also for form and size of the seeds. No one will make a mistake when selecting *glauca* and *indica* seeds out of a mixture of both, but counting types in a mixture of hybrids seems to me impossible, difficult as it is to judge the seeds of a single plant, which all of them have the same seed coat constitution.

SUMMARY.

1. The F_1 offspring of the cross *Canna glauca* × *indica* segregates for the factors of the red leaf margin, for the layer of wax on the leaves, the number and colour of staminodes in ratios that differ widely in different sowings, in spite of the fact that the F_1 consists of a single individual; so there is variability in segregation of the hybrid.

2. The factor **A** causes red flower colour, **aa** plants have yellow flowers. **B** produces together with **A** the broad red leaf margin. The factor **C** necessary in crosses of *C. indica* with its own green leaved variety as third factor for broad red leaf edges (and wherein plants containing **C** but without **A** and **B** both together, showed a very narrow red leaf margin) seems to be absent or totally prohibited in its demonstration in the cross with *glauca*. In some F_2 sowings the inheritance of **A** and **B** proceeds on ordinary Mendelian lines (9 : 7 ratio), in three batches the ratio is 1 : 1. In F_3 the 1 : 1 ratio appeared again, but also 9 : 7 and 3 : 1.

D, **E** and **F** are intensification factors for the red colour factor **A** and also for **R**, the factor for patched staminodes. One of the intensifiers **E** is coupled to a high degree with **B**. From the back cross of $F_3/10—3$ with *glauca* resulted that the *glauca* used for the back cross J4—2—3 was heterozygous for **D**.

G is an extensification factor for anthocyanin in the leaves. That F_1 has much redder leaves than *indica* depends on the factor **G**, cryptomeric in *glauca* and coupled with a factor for wax.

K and **L** are polymeric factors for the wax layer on the leaves of *glauca*. Judging from the thickness of the wax layer *glauca* should be heterozygous for both factors. The back cross of F_1 by *glauca* however suggests homozygosity of at least one of both.

M, **N** and **O** may be three polymeric factors for the third staminode, which becomes probable from the ratios in F_2, but far from certain on account of the results of the back cross of F_1 with *indica*.

Q is a lethal factor, in (*glauca* × $F_3/10—3$) absolutely coupled with **A**, killing all **AA** plants in the offspring after selfing that hybrid. Probably it is the same factor that in *glauca* is coupled with **R** and being homozygous kills all **RR** plants.

H and **I** are the factors that constitute together the difference between the deep yellow chromatophores in the staminodes of *indica* and the pale yellow ones in those of *glauca*.

J is a factor for deeper vein colouring present in most red flowered hybrids, almost invisible in the deep reds, clearly visible in the pale ones. Perhaps the central red colouring in a yellow margin is caused by the same factor **J**. *C. glauca* should be **Jj.**

P is an extensification factor for the central colouring. **PP** and **Pp** plants have much narrower yellow staminode margin. In *glauca* **P** should be present heterozygously.

R causes homozygously red patches in yellow flowers spread over the whole breadth of the staminode and heterozygously such spots in the middle of the staminode only. For this factor **R** *glauca* is a constant heterozygote owing to the presence of the lethal factor Q.

3. So far we can judge now (putting not quite certain factors in brackets,

and marked with a point when homo- or heterozygosis is unknown) *C. indica* will be **AABB(CC)DD(EE)FFggHHIIjjkkll(mmnnoo)ppqqrr** and *glauca* **aabb(cc)DdeeffG.hhiiJjKkL.(M.N.O.)PpQqRr.**

4. It is not certain whether the variability of segregation is caused by irregular distribution of the chromosomes whether or not followed by differential fertilization or differential mortality of gametes or differential mortality of zygotes. Shortly I hope to be able to give some cytological information.

5. As a rule the F_2 and F_4 are more regular in their segregation than the F_2; clean cut Mendelian ratios reappear.

6. It has not been possible to work out a factorial analysis for leaf length and breadth, staminode length and breadth, form, size and colour of the seeds.

7. Measuring all leaves of F_1 and separate F_2 specimens and adding the figures for each plant separately, gives curves irregular on the minus side where the limits of variation are extremely wide. For F_2 as a whole this irregularity has vanished and the F_2 standard deviation for leaf length is even smaller than that of the F_1 which is one single individual. The staminode length is far less dependent on the position on the floral axis than the leaf length is dependent on the position on the stem.

I wish to express my thanks to Dr. S. C. J. Jochems for having described some late blooming hybrids with the aid of Oberthür after my departure from Medan, and to Mr. B. J. van Tongeren for the fine pictures of *Canna* flowers after which the plates I, II and III have been made.

EXPLANATION OF PLATES.

PLATE I. (± 3/5 nat. size).

Fig. 1–2. *Canna indica* (the shade of red is not deep enough).
„ 3. *C. glauca* × *indica* F_1.
„ 4. *C. glauca*.
„ 5–6. F_4 specimens of the F_2/37 family with red ovary.
„ 8–9. F_4 specimens of the F_2/37 family with green ovary.
„ 8. Abnormal flower with 3 labella.

PLATE II. (± 3/5 nat. size).

Fig. 1. F_4/10—3—4.
„ 2. F_3/10—3 not opened flower.
„ 3. J4—2—3 × F_3/10—3, the only specimen with a trifle deeper shade of red.
„ 4. J4—2—3 × F_3/10—3 type (± 200 individuals).
„ 5. *C. glauca*.
„ 6–9. F_3 children of F_2/162, fig. 8 with two staminodes.

PLATE III. (± 3/5 nat. size).

Fig. 1. F_2/75.
„ 2–4. F_3 plants of F_2/75, flowers deep yellow.
„ 5–6. F_3 plants of F_2/75, flowers yellow.
„ 7. F_3 plant of F_2/75, flowers pale yellow.

PLATE IV.

Fig. 1. Transverse section of staminode of *C. indica*, 350 ×.
„ 2. Transverse section of staminode of *C. glauca*, 350 ×.

PLATE V.

Fig. 1. F_3/10—2 on first day.
„ 2. F_3/10—2 on second day, bleached.
„ 3–8. F_4/10–2 specimens.
„ 6. is a young not fully opened flower, fig. 7 an old already bleached one. This peculiar keeping-closed often occurred also on the motherplant F_3/10—2.

PLATE VI.

Unripe fruits of *C. indica* (deep red), *C. glauca* × *indica* F_1 (much brighter red) and *C. glauca* (green).

PLATE VII.

Ripe fruits of *C. indica* (opens its carpels), *C. glauca* × *indica* F_1 (does not at all or scarcely open its carpels), *C. glauca* (keeps its carpels closed).

PLATE VIII.

The creeping power of the rhizom of *C. glauca* demonstrated by the hybrid F_2/nr. 4. The spot where it was originally planted is marked by a gaspipe with a *Canna* leaf in top. Creeping distance two meters and a half in one year and a half.

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B. J. VAN TONGEREN DEL.

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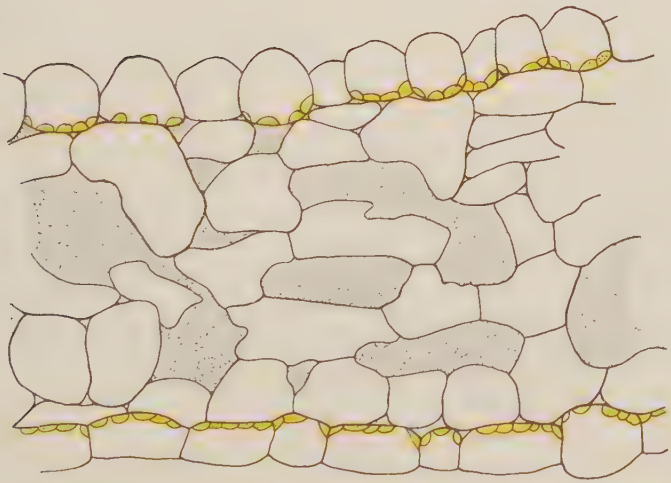

RECENT SHELLS FROM JAVA

PART I. — GASTROPODA

BY

DR. C. H. OOSTINGH

INTRODUCTION.

This paper deals with the first part of a collection of chiefly marine shells from the isle of Java, which is kept in the Geological Museum of the Agricultural University at Wageningen (Holland). As the exact knowledge of the recent molluscan fauna of Java is of much importance for the study of the upper tertiary fauna of that island, I have thought it useful to deal with it rather in detail.

By far the greater part of the collection was made by Prof. J. VAN BAREN, Wageningen and by Dr. J. M. GEERTS and Mrs. S. J. GEERTS—RONNER at Surabaya. During his stay in Java in 1916 Prof. VAN BAREN collected in the western and central part of Java, chiefly on the coast, whilst the collection of Dr. GEERTS was made on the coasts of East-Java, thus completing the collection of Prof. VAN BAREN. Some non-marine mollusca were collected by Mr. L. G. E. KALSHOVEN. We are particularly grateful for the permission to retain the specimens collected by Dr. GEERTS, Mrs. GEERTS and Mr. KALSHOVEN and I avail myself of this opportunity to express my thanks to Prof. VAN BAREN, who travelled in Java to make agrogeological researches, for the pains he has taken besides in collecting shells at my request.

Several specimens collected by Prof. VAN BAREN have been identified by the late M. M. SCHEPMAN and I am also indebted to Dr. ED. LAMY in Paris and to Dr. B. PRASHAD of Calcutta for information and intelligence. During my sojourn in Frankfurt-on-Main I was able to avail myself of the rich library in the Senckenberg Museum, owing to the courtesy of Dr. Fr. HAAS, to whom I tender cordial thanks.

THE LOCALITIES.

The localities from which the shells that form the subject of this paper were collected have been indicated on the appended sketch-map under their respective numbers.

1. Coast near mouth of river Tji Lamaja; Residency Batavia, Krawang-Division. Mud-flat exposed at low tide. Among the shells collected here by Prof. VAN BAREN are several freshwater shells, carried here by the river.
2. Coral-island Pulu Pandjang near Japara; Residency Semarang, Japara-Division (VAN BAREN).
3. Coast near Government Rubber Estate Balong, N. E. of Japara; Resid. Semarang, Japara-Division (VAN BAREN). Sandy coast.
4. Surabaya, Harbour, mud-flat, exposed at low tide (Dr. GEERTS and Mrs. GEERTS).
5. Shore of Bandjaran, east of Surabaya-city (GEERTS). The shells have been collected on a small sandy beach, which is situated amidst mangrove-swamps etc..
6. Shore west of Panarukan; Residency Besuki, Panarukan-Division (GEERTS).
7. Shore of Bali-strait, north of Banjuwangi; Resid. Besuki, Banjuwangi-Division (GEERTS).
8. Bay of Popoh; Residency Kediri, Tulungagung-Division (GEERTS).
9. Mantjingan; Residency Jokjakarta, Mataram-Division, district Kreteg (Prof. VAN BAREN and Mr. KALSHOVEN). The shells have been collected on a small sandy beach before the rocky coast.
10. Shore east of Gunung Selok; Residency Banjumas, Tjilatjap-Division, district Adiredja (VAN BAREN). Sandy coast.
11. Schildpadden-bay, east of Tjilatjap; Resid. Banjumas, Tjilatjap-Division, district Tjilatjap. Some bivalves have been collected on the sandy beach by Dr. J. JESWIET.
12. Shore near Tjilatjap (VAN BAREN). Sandy coast.
13. Tji Solok, Wijnkoopsbay; Residency Preanger Regent-

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schappen, Sukabumi-Division, district Palabuhan (Van Baren).
Sandy beach amidst cliffs.

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14. Buitenzorg, Botanical Gardens; Residency Batavia, Buitenzorg-Division (Van Baren).
15. Forest near Mountain Gardens of Tjibodas (S. E. of Buitenzorg); Residency Preanger Regentschappen, Tjiandjur-Division (Kalshoven).
16. Forest on the northwestern slope of the Malabar, S. of Bandjaran; Residency Preanger Regentschappen, Bandung-Division (Van Baren).
17. Penawangan; Residency Semarang, Semarang-Division. The locality Penawangan is situated E. of Ungaran and S. of Mranggen (**not** Penawangan near Poerwodadi!).
Mr. Kalshoven collected here in the teakwoods and in the sawah's (rice-fields).
18. Goendih, south of Poerwodadi; Residency Semarang, Grobogan-Division, district Poerwodadi (Van Baren).
19. Teakwood S. W. of Bandjarredjo (S. W. of Blora); Residency Rembang, Blora-Division, district Karangdjati. Some land-snails collected by Dr. J. Beumée.
20. River Kali Sampean, Situbondo; Residency Besuki, Panarukan-Division. Some *Melaniidae* from the collection of Dr. Keyzer.
21. Sawah's (rice-fields) near Pradjekan, south of Situbondo; Residency Besuki, Panarukan-Division, district Pradjekan. Some *Melaniidae* from the collection of Dr. Keyzer.

Besides the shells with exact locality there are some marine shells, collected by Dr. Geerts and Mrs. Geerts on the coasts of Java, of which no precise locality is known.

PROSOBRANCHIA.

FAM. ACMAEIDAE.

1. **Acmaea striata** Quoy et Gaimard sp..

1834 *Patelloïda striata*. Quoy et Gaimard, Voyage de l'Astrolabe (96) [1]), vol. III, p. 353, pl. 71, figs. 8—11.

1836 *Patelloida* — Quoy. Deshayes in Lamarck, An. s. vert. (53), vol. VII, p. 552, nr. 11.

1854 *Patella* — Quoy. Reeve (97), vol. VIII, Patella, pl. XXIII, figs. 58 a, b (*not* pl. XXXIII, fig. 99).

1855 — *Borneensis*. Reeve, ibid., pl. XXXVI, figs. 113 a, b.

1891 *Acmaea striata* and var. *borneensis*. Pilsbry, Manual (109), vol. XIII, pp. 47, 48, pl. 19, figs. 37, 38; pl. 35, figs. 25—29.

1908 — — — — — Horst et Schepman, Catalogue syst. Mus. des Pays-Bas (31), pp. 500, 501.

1908 — — ,var. *borneensis*. Schepman, Siboga expedition (104), p. 95.

Shore of Bali-strait, north of Banjuwangi, 2 specimens. The shells are rather distinctly striated, they are externally coloured blackish brown all over. Inside sky-blue with black margin and brown central area. I think they belong to the typical form.

Measurements of shells (in millimetres):

	Length	Breadth	Altitude
A	$32^1/_2$	29	$11^1/_2$
B	$28^1/_2$	24	8

1) The numbers in parenthesis refer to the list of consulted works and papers at the end.

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Pulu Weh N. of Sumatra, N. coast of Borneo, Northern Celebes, Sangir-(Sangi-) islands N. of Celebes, Flores, Solor Is., Amboina, Misol, New Guinea.

—— Philippine Is..

2. **Acmaea saccharina** Linné sp..

1705	*Lepas sive Patella.*		Rumphius (100), p. 121, pl. XL, fig. B.
1758	*Patella saccharina.*		Linné, Systema Naturae, edit. X, p. 781, nr. 660.
1767	—	—	Linné, Systema Naturae, edit. XII, p. 1258.
1819	—	—	Lamarck, An. s. vert. (52), vol. VI, 1st part, p. 326, nr. 7.
1836	—	—	Linn.. Lamarck, An. s. vert. (53), vol. VII, pp. 527—528.
1855	—	—	Linn.. Reeve (97), vol. VIII, Patella, pl. XXVIII, figs. 72 a, b, c.
—	—	*lanx.*	Reeve, ibid., pl. XXX, figs. 82 a, b.
1869	—	*saccharina.*	Lischke, Japan. Meeresconch. (59), vol. I, p. 113.
1891	*Acmaea saccharina.*		Pilsbry, Manual (109), vol XIII, pp. 49—50, pl. 36, figs. 60—62, 78; pl. 18, figs. 31, 32; pl. 24, figs. 12, 13.
1902	—	—	von Martens, Rumphius Gedenkboek (71), p. 124.
1908	—	—	and var. *lanx* Reeve. Horst et Schepman, Catalogue (31), p. 501.
1908	—	—	Schepman, Siboga expedition (104), p. 96.

Shore of Bali-strait, north of Banjuwangi, 1 worn specimen.

Distribution: East Indian Archipelago, chiefly in the eastern part: Northern Celebes, Togean Is. near Celebes, Siau-island and Sangir-(Sangi-)islands N. of Celebes, Talaut Is. N. E. of Celebes, Kangeang-island E. of Madura, Flores, Timor, Banda, Amboina, Waigeu-island.

— Philippines, Japan. — Viti Is..

FAM. **PATELLIDAE.**

3. **Patella (Scutellastra) pica** Reeve.

1854 *Patella pica*. Reeve, Conch. Icon. (97), vol. VIII, Patella, pl. XIX, figs. 45 a—c; pl. XXVI, figs. 68a, b.
1854 *Patella Chitonoides*. Reeve, ibid., pl. XXI, figs. 52 a, b.
1891 — (*Scutellastra*) *pica*. Pilsbry (109), vol. XIII, pp. 97—98, pl. 22, figs. 9, 10, 13, 14; pl. 59, figs. 47—49; pl. 26, figs. 28 29.
1906 — *chitonoides* Reeve. Dautzenberg et H. Fischer, Indo-Chine (18), pp. 448—449.
1908 — (*Scutellastra*) *pica*. Horst et Schepman, Catalogue (31), p. 506.

Tji Solok, Wijnkoopsbay, 5 specimens.
Tjilatjap (Leyden Museum).
Distribution: Cochin China. — Mauritius, Réunion, Madagascar.

4. **Helcioniscus testudinarius** Linné sp..

1705 *Lepas sive Patella*. Rumphius (100), p. 121, pl. XL, fig. A.
1758 *Patella testudinaria*. Linné, Systema Naturae, edit. X, p. 783, nr. 674.
1767 — — Linné, Systema Naturae, edit. XII, p. 1260.
1819 — — Lamarck, An. s. vert. (52), vol. VI, 1st part, p. 329, nr. 21.
?1834 *Lottia* — Sowerby, Genera (105), Lottia, fig. 2.
1836 *Patella* — Lin.. Lamarck, An. s. vert. (53), vol. VII, p. 532.
1854 — — Reeve (97), vol. VIII, Patella, pl. IV, figs. 6 a, b.
1855 — — Hanley, Ipsa Linnaei Conchylia, p. 427.
1866 — *insignis*. Dunker in: Verhandl. d. Zoologisch-Botanischen Gesellschaft in Wien, 1866, p. 941.
1891 *Helcioniscus testudinaria*. Pilsbry (109), vol. XIII, pp. 128—129, pl. 25, figs. 16—19.

1902 *Patella testudinaria*. von Martens, Rumphius Gedenkboek (71), p. 124.
1908 *Helcioniscus testudinarius*. Horst et Schepman, Catalogue (31), p. 510.
1908 — — Schepman, Siboga exp. (104), p. 98.

Tji Solok, Wijnkoopsbay, 1 specimen.
Palabuan, Wijnkoopsbay (von Martens). Tjilatjap (Leyden Museum).
Distribution: East Indian Archipelago: Flores, Flores Sea, Amboina, Obi, Bachan, Halmahera, Morotai, Northern Celebes, Waigeu, Misol, New Guinea.
— Singapore, Philippines. — Cape of Good Hope.

5. **Helcioniscus eucosmius** Pilsbry.

1854 *Patella variegata*. Reeve (97), vol. VIII, Patella, species 36, pl. XVI, figs. 36 a—c.
1891 *Helcioniscus eucosmia*. Pilsbry (109), vol. XIII, pp. 148—149, pl. 71, figs. 61—64.
1906 *Patella eucosmia*. Dautzenberg et H. Fischer, Indochine (18), p. 448.
1908 *Helcioniscus eucosmius*. Horst et Schepman, Catalogue (31), p. 512.
Not *P. variegata* of De Blainville (1825), nor of Reeve, Conchologia Systematica (1842).

Tji Solok, Wijnkoopsbay, 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: Timor. — Gulf of Siam, Japan. — Red Sea, Gulf of Suez, Gulf of Akabah.
— Cape of Good Hope.

6. **Helcioniscus enneagonus** Reeve sp..

1854 *Patella enneagona*. Reeve (97), vol. VIII, Patella, pl. XVIII, figs. 44 a, b.
1891 *Helcioniscus enneagona*. Pilsbry (109), vol XIII, p. 152, pl. 28, figs. 35, 36.
1908 — *enneagonus*. Horst et Schepman (31), p. 512.
1908 — — Schepman (104), p. 98.

Tji Solok, Wijnkoopsbay, 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: Eastern part of the Malay Archipelago: Flores, Timor, Waigeu-island.

FAM. **FISSURELLIDAE.**

7. **Subemarginula (Clypidina) notata** Linné sp..

1767 *Patella notata*. Linné, Systema Naturae, edit. XII, p. 1261.
1819 — — Lamarck, An. s. vert. (52), vol. VI, 1st part, p. 332, nr. 32.
1836 — — Lamarck, An. s. vert. (53), vol. VII, p. 536.
1866 *Emarginula notata*. A. Adams and G. B. Sowerby in: Sowerby, Thesaurus (106), vol. III, p. 220, figs. 86—88.
1873 — — Sowerby in Reeve (97), vol. XIX, Emarginula, pl. VI, figs. 42 a, b.
1890 *Subemarginula* (*Clypidina*) *notata*. Pilsbry (109), vol. XII, p. 282, pl. 64, figs. 34,35.
1908 — *notata*. Horst et Schepman (31), p. 495.

Tji Solok, Wijnkoopsbay, 3 specimens.
Tjilatjap (Leyden Museum).
Distribution: Cape of Good Hope.
The habitat „West Indies", given by Lamarck and also by Adams was doubted by Pilsbry, who thought it to belong rather to the East Indian type. Our specimens and those in the Leyden Museum prove that Pilsbry's supposition was exact.

FAM. **TURBINIDAE.**

8. **Turbo (Senectus) ticaonicus** Reeve.

1842 *Turbo Ticaonicus*. Reeve in: Proceedings of the Zoological Society of London, 1842, p. 185.
1848 — — Reeve (97), vol. IV, Turbo, fig. 23.
1873 — (*Senectus*) *Ticaonicus*. Paul Fischer in Kiener (32), vol. X, Turbo, pp. 87, 124, pl. 32, fig. 2.
1888 — — *ticaonicus*. Pilsbry (109), vol. X, p. 202, pl. 47, fig. 22; pl. 43, fig. 51.
1902 — *Ticaonicus* Reeve. von Martens, Rumphius Gedenkboek (71), p. 113.

1908 *Turbo* (*Senectus*) *ticaonicus*. Horst et Schepman (31), p. 441.
1908 — — — Schepman (104), p. 24.
1911 — — — H. Martin-Icke (76), p. 47.
1920 — — — Tesch, Timor (108), II, p. 78, pl. CXXXIII, fig. 219.

Shore of Bali-strait, north of Banjuwangi, 1 specimen.

Near reef of Batjulmati, East coast (Siboga expedition).

Distribution: East Indian Archipelago: Banka, Kangeang-island (eastward of Madura), Lombok, Paternoster-islands, Flores, Solor Is., Rotti, Timor, Amboina, Togean Is., Halmahera, Misol, New Guinea, Talaut-islands (north of Celebes). — Philippines (a. o. the island of Ticao, after which the species has been named), Singapore, Andamans, Seychelles, Madagascar. — New Caledonia.

Fossil in the Pliocene (Sondé beds) near Trinil (Resid. Madiun), Java. Upper Pliocene or Lower Pleistocene of Timor.

Our specimen from Banjuwangi shows a very small umbilical slit, as do some specimens of the Siboga expedition.

FAM. **TROCHIDAE.**

9. **Trochus (s. str.) niloticus** Linné.

1767 *Trochus niloticus*. Linné, Systema Naturae, edit. XII, p. 1227.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 17, nr. 25.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 132.
1847-'48 — — Philippi, Trochus in Conch.-Cab. (92), p. 32, pl. 7, fig. 1; pl. 8, fig. 1.
1867 — — von Martens (63).
1869 — — Lischke, Japan. Meeresconch. (59), vol. I, p. 91.
1875 *Trochus Niloticus*. Paul Fischer in Kiener (32), vol. XI, Trochus, p. 66, pl. 10.
1879 *Trochus (s. str.) Niloticus*. P. Fischer, ibid., p. 414.
1886 *Trochus niloticus*. Boog Watson, Challenger Gasterop. (8), p. 50.
1887 — — von Martens, Mergui (67), p. 196.

1889 *Trochus (s. str.) niloticus.* Pilsbry (109), vol. XI, p. 17, pl. 1, figs. 5—8.
1902 *Trochus Niloticus* L.. von Martens, Rumphius Gedenkboek (71), p. 114.
1908 *Trochus (s. str.) niloticus.* Horst et Schepman (31), p. 448.
1908 — — — Schepman (104), p. 37.
1909 *Trochus niloticus.* Lamy, Java (56), p. 467.
Not *Trochus niloticus* Reeve (= *maximus* Koch).

Shore of Bali-strait north of Banjuwangi, 3 specimens.
Bay of Popoh, South coast of Residency Kediri, 1 specimen.
Tjilatjap (Leyden Museum). Madura (Leyden Mus.).
Distribution: East-Indian Archipelago: Mentawei-islands near Sumatra, Pulu-tikus near Benkulen (Sumatra), Banka, Borneo-bank, Sumbawa, Flores, Sumba, Dana-island, Timor, Lucipara-island, Amboina, Celebes, Waigeu, Misol, New Guinea. — New Ireland, New Caledonia, Viti Is., Samoa, North Australia.
— Japan. — Singapore, Mergui Archipelago, Nicobars, Coromandel Coast, Ceylon.

10. **Trochus (s. str.) maximus** Koch.

1844 *Trochus maximus.* Koch in Philippi, Abbildungen (86), vol. I, p. 138, Trochus, pl. IV, fig. 3.
1849 — — Philippi, Trochus in Conch. -Cab. (92), p. 115, pl. 19, fig. 4.
1862 *Trochus niloticus* (*not* of Linné). Reeve (97), vol. XIII, Trochus, species 3, pl. I, figs. 3 a, b.
1867 *Trochus maximus*, Koch. von Martens (63).
1875 — — Paul Fischer in Kiener (32), vol. XI, Trochus, p. 67, pl. 11 (*Tr. marmoratus* on the plate).
1879 *Trochus (s. str.) maximus.* P. Fischer, ibid., p. 414.
1889 *Trochus (s. str.) niloticus* L., var. *maximus* Koch. Pilsbry (109), vol. XI, p. 18, pl. 1, fig. 9.
1908 *Trochus (s. str.) maximus.* Horst et Schepman (31), p. 448.

Coral-island Pulu Pandjang, a young specimen.
Distribution: Billiton. — Singapore, Cochin China, Viti Is..

The specimen from Pulu Pandjang measures 31 m.m. by 31 m.m.. Though young, it could be distinguished from specimens of *Tr. niloticus* of the same age by the somewhat smaller apical angle and principally by the persistence of the sculpture on the last whorl.

11. **Trochus (Tectus) fenestratus** Gmelin.

1788-'90 *Trochus fenestratus.* Gmelin, Syst. Nat. (27), p. 3582, nr. 100.
1843 — — Deshayes in Lamarck, An. s. vert. (53), vol. IX, p. 156, nr. 76.
1849 *Trochus caperatus.* Philippi, Trochus in Conch.-Cab. (92), p. 107, pl. 17, fig. 7.
— — *exaltatus.* Philippi, ibid., p. 108, pl. 17, fig. 8.
1852 *Trochus circumsutus.* Gould, Mollusca and Shells in: U. S. Explor. Expedition 1838–'42, vol. 12, pl. 13, fig. 220.
1861 *Trochus exaltatus* Philippi. Reeve (97), vol. XIII, Trochus, spec. 16, pl. IV, fig. 16.
— — *crenulatus* (*not* of Lamarck). Reeve, ibid., spec.17, pl. IV, fig. 17.
— — *fenestratus* Gmelin. Reeve, ibid., spec. 18, pl. IV, fig. 18.
1876 *Trochus fenestratus.* Paul Fischer in Kiener (32), vol. XI, Trochus, p. 117, pl. 38, fig. 3.
1879 *Trochus (Tectus) fenestratus.* P. Fischer, ibid., p. 414.
1889 — — — Pilsbry (109), vol. XI, p. 22, pl. 4, figs. 28, 29.
1899 — — — Melvill and Standen, Torres Straits (77), p. 175.
1908 — — — Horst et Schepman (31), p. 449.
1908 — *(s. str.)* — Schepman (104), p. 37.

Coral-island Pulu Pandjang, 1 specimen.
Shore of Bali-strait, north of Banjuwangi, 1 specimen.

Tjilatjap (Leyden Museum). Madura (Leyden Mus.).

Distribution: East Indian Archipelago: Borneo-bank (Strait of Makassar), Kangeang-island (east of Madura), Flores, Timor, Lucipara-island, Banda, Amboina, Obi, Sula-islands, Waigeu, Aru Is., New Guinea.
— Torres Straits, New Caledonia, Viti Is., Samoa. — Sulu-archipelago, Philippines.

12. **Trochus (Lamprostoma) maculatus** Linné.

1705 *Trochus secundus.* Rumphius (100), p. 74, pl. XXI, figs. C, 5.
1758 *Trochus maculatus.* Linné, Systema Naturae, edit. X, p. 756, nr. 502 (in part).
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 19, nr. 31.
— — *granosus.* Lamarck, ibid., p. 20, nr. 32.
1843 — *maculatus.* Lamarck, An. s. vert. (53), vol. IX, p. 136.
— — *granosus.* Lamarck, ibid, p. 137.
1846 — *Gmelini.* Jonas in: Zeitschrift für Malakozoologie, p. 123.
1848 — *rugulosus.* Koch in: Zeitschr. f. Malakoz., p. 128.
1849 — *callicoccus.* Philippi in: Zeitschr. f. Malakoz., p. 150.
1849 — *acutangulus* (*not* of Chemnitz). Menke in Philippi, Trochus in Conch.-Cab. (92), p. 101, pl. 16, fig. 12.
1851 *Polydonta gibberula.* A. Adams in: Proceedings Zoological Society of London, p. 155.
1855 *Trochus Jonasi.* Philippi, Trochus in Conch.-Cab. (92) p. 260, pl. 38, figs. 9, 10.
1861 *Trochus altus* (*not* of Philippi). Reeve (97), vol. XIII, Trochus, pl. III, fig. 13.
— — *smaragdus.* Reeve, ibid., pl. XII, fig. 66.
— — *gibberulus* Adams. Reeve, ibid., pl. XII, fig. 67.
1862 — *maculatus.* Reeve, ibid., species 4, pl. I, fig. 4; pl. XII, figs. 4 b, 4 c.
1876 — — P. Fischer in Kiener (32), vol. XI, Trochus, p. 101, pl. 29, figs. 1, 1a.
— — *granosus.* P. Fischer, ibid., p. 107, pl. 34, fig. 1.
1879 *Trochus (Polydonta) maculatus.* P. Fischer, ibid., p. 415.
— — — *granosus.* P. Fischer, ibid., p. 415.
1887 — — *maculatus.* von Martens, Mergui (67), p. 196.
1889 *Trochus (Lamprostoma) maculatus* Linné and var. *granosus* Lam.. Pilsbry (109), vol. XI, pp. 24—25, 26, pl. 9, figs. 94, 95, 100, 1—4; pl. 6, figs. 51, 60.
1895 — *maculatus* Linné. Schepman, Borneo (102), p. 162.
1899 — *(Lamprostoma) maculatus.* Melvill and Standen, Torres Straits (77), p. 175.

1902 *Trochus maculatus* L.. von Martens, Rumphius Gedenkboek (71), p. 114.
1903 *Trochus (Infundibulum) maculatus* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 264, 280—281.
1908 *Trochus (Lamprostoma) maculatus* L. and var. *granosa* Lam.. Horst et Schepman (31), pp. 450, 451.
1908 — — — — and var. *granosus* Lam.. Schepman (104), p. 38.
1911 — — — Lam. H. Martin–Icke, Trinil (76), p. 49.
1919 — *maculatus* Lamk.. K. Martin (75), p. 102.

Coral-island Pulu Pandjang, 2 specimens. One belongs to the form *granosus* Lamk., the other is nearly intermediate between this form and the typical *maculatus*, the last whorl being but slightly constricted around the upper portion.
Shore of Bali-strait, north of Banjuwangi, 1 specimen of the form *granosus*.
Tjilatjap (Leyden Museum). Madura (var. *granosa*) (Leyden Mus.).

Measurements of shells (in millimetres):

	Alt.:	Maximum diameter:
Pulu Pandjang (*granosus*)	34	$33^1/_2$
Pulu Pandjang (intermediate form)	37	39
Bali-strait	$41^1/_2$	43

Distribution: East Indian Archipelago: Mentawei-islands west of Sumatra, Sumatra, Banka, Billiton, Sambas (Borneo), Northern Celebes, Talaut-islands N. E. of Celebes, Lombok, Sumbawa, Flores, Timor, Lucipara-islands, Amboina, Sula Is., Bachan, Waigeu, Kei Is..
— Torres Straits, Port Essington (Northern Australia), New Caledonia, Viti Is., Kingsmill- or Gilbert-islands, Philippines, Japan. — Singapore, Mergui Archipelago, Ceylon. — Red Sea and Gulf of Akabah, Mozambique.
Fossil in the Pliocene of Java (Resid. Madiun).

13. **Trochus (Infundibulum) radiatus** Gmelin.

1788-'90 *Trochus radiatus*. Gmelin, Syst. Nat. (27), p. 3572, nr. 33.
1848 *Trochus eucosmus*. Philippi in: Zeitschrift für Malakozoologie, 1848, p. 104.
1848 *Trochus radiatus*. Philippi, Trochus in Conch.-Cab. (92), p. 46, pl. 10, figs. 6—8.
1849 — *festivus*. Philippi, ibid., p. 116, pl. 19, fig. 5.
1855 — *eucosmus*. Philippi, ibid., p. 260, pl. 38, fig. 11.
1861 *Trochus vividus*. Reeve (97), vol. XIII, Trochus, species 72, pl. XIII, fig. 72.
— — *radiatus*. Reeve, ibid., species 80, pl. XIV, fig. 80.
— — *sugillatus*. Reeve, ibid., species 85, pl. XIV, fig. 85.
1878 *Trochus radiatus*. P. Fischer in Kiener (32), vol. XI, Trochus, p. 304, pl. 97, fig. 1.
1879 *Trochus (Infundibulum) radiatus*. P. Fischer, ibid., p. 415.
1887 — *(Polydonta) radiatus*. von Martens, Mergui (67), p. 196.
1889 — *(Infundibulum) radiatus*. Pilsbry (109), vol. XI, p. 37, pl. 8, figs. 86, 88—93; pl. 42, fig. 8; pl. 43, figs. 9, 10.
1899 *Infundibulum radiatum*. Dautzenberg, Sumatra (15), p. 4.
1908 *Trochus (Infundibulum) radiatus*. Horst et Schepman (31) p. 452.
1919 *Trochus radiatus*. K. Martin (75), pp. 102, 151.

Tji Solok, Wijnkoopsbay, many specimens.
Java (without exact locality), 2 specimens.
Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Olehleh (Achin, Northern Sumatra) (Museum Wageningen), between Padang and Indrapura (West coast of Sumatra), Banka, Timor. — Singapore, Mergui Archipelago, Ceylon, Red Sea, Madagascar. — Philippines.

Fossil in the Upper Miocene of Java.

14. **Monodonta (s. str.) labio** Linné sp..

1705 *Trochus quartus* (Diklip, Labeo). Rumphius (100), p. 75, pl. XXI, fig. E.
1758 *Trochus Labio*. Linné, Systema Naturae, edit. X, p. 759.
1767 — — Linné, Syst. Nat., edit. XII, p. 1230.

1780 *Trochus Labio.* Ign. de Born, Testacea musei caes. Vindobonensis, p. 335, pl. 12, figs. 7, 8.
1781 *Trochus Labeo* etc.. Chemnitz, Conchylien-Cabinet, vol. V, p. 60, pl. 166, figs. 1579—1580.
1788-'90 *Trochus Labio* L.. Gmelin, Syst. Nat. (27), p. 3578, nr. 76.
1815 *Trochus (Monodonta) Labio.* S. Brookes, Introduction to the study of Conchology, p. 123, pl. 7, fig. 95.
1817 *Trochus labeo.* Dillwyn, A descriptive Catalogue of recent shells, vol. II, p. 792, nr. 80.
1822 *Monodonta labio.* Lamarck, An. s. vert. (52), vol. VII, p. 34, nr. 10.
1825 *Turbo labio.* Blainville, Manuel de Malacologie et de Conchyliologie, p. 428, pl. 33, figs. 4, 4a.
1825 *Trochus Lubeo.* W. Wood, Index Testaceologicus; or a Catalogue of Shells, p. 138, pl. 29, fig. 80.
1832 *Trochus Labeo.* Sowerby, Genera (105), Trochus, fig. 5.
1832 *Trochus labio.* Deshayes, Encyclopédie méthodique; Vers, vol III, p. 1080, nr. 30.
1843 *Monodonta labio.* Lamarck, An. s. vert. (53). vol. IX, p. 176—177, nr. 10.
1851-'55 *Trochus labio.* Philippi, Trochus in Conch.-Cab. (92), pp. 166, 306, pl. 27, figs. 1—3; pl. 44, fig. 8.
1859 *Monodonta labio.* Chenu, Manuel (11), vol. I, p. 358, fig. 2652.
1869 *Trochus labio.* Lischke, Japan. Meeresconch. (59), vol. I, p. 95.
1877 — — P. Fischer in Kiener (32), vol. XI, Trochus, p. 223, pl. 73, fig. 1; pl. 74, fig. 4.
1879 *Trochus (Labio) labio.* P. Fischer, ibid., p. 421.
1886 *Trochus (Monodonta) labio.* Boog Watson, Challenger Gasterop. (8), p. 53.
1889 *Monodonta labio.* L. Morlet in: Journal de Conchyliologie, vol. XXXVII, p. 159.
— — — Crosse et Fischer in: Journ. de Conchyl., vol. XXXVII, p. 290.
1889 — — Pilsbry (109), vol. XI, p. 86, pl. 19, figs. 95, 96.
1891 — — P. Fischer, Indo-Chine (22), p. 204 (120).
1895 — — Linné. Schepman, Borneo (102), p. 162.
1902 *Trochus (Labio) labio.* von Martens, Rumphius Gedenkboek (71), p. 114.

1905 *Monodonta labio.* Dautzenberg et H. Fischer, Tonkin (17), pp. 187—189.
1908 *Monodonta (s. str.) labio.* Horst et Schepman (31), p. 455.
1908 — — — Schepman (104), p. 40.
1912 — — — K. Martin, Vorläuf. Bericht (74) p. 169.
1919 *Monodonta labio.* K. Martin (75), pp. 102, 133.

Coral-island Pulu Pandjang, 2 specimens.

Both specimens are small: Alt. 17, diameter 16 mill..

Tjilatjap (Leyden Museum). Madura (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Billiton, Sambas (Borneo), Celebes, Talaut Is. N. E. of Celebes, Lombok, Sumbawa, Flores, Tanah-Djampeah (Flores Sea), Dammer-island (N. E. of Timor), Amboina, Halmahera, New Guinea. — Cape York (North Australia). — Sulu Sea (N. E. of Borneo).

Japan, China, Indo-China, Singapore, Further India, Nicobars, Madras, Ceylon, East African coasts, Natal.

Fossil in the Pliocene of Java.

15. **Chrysostoma paradoxum** Born sp..

1780 *Helix paradoxa.* Ign. de Born, Testacea musei caes. Vindobonensis, p. 394, pl. 13, figs. 16, 17.
1781 *Chrysostomus Nicobaricus.* Chemnitz, Conchylien-Cabinet, vol. V, p. 216, pl. 182, figs. 1822—1825.
1788-'90 *Turbo Nicobaricus.* Gmelin. Syst. Nat. (27), p. 3596, nr. 33.
1822 *Turbo nicobaricus.* Lamarck, An. s. vert. (52), vol. VII, p. 48, nr. 26.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 214.
1847 — — Philippi, Turbo in Conch.-Cab. (91), p. 34, pl. 8, figs. 14—17.
1848 — *Nicobaricus.* Reeve (97), vol IV, Turbo, pl. XI, fig. 48.
1859 *Chrysostoma nicobarica.* Chenu, Manuel (11), vol. I, p. 354, fig. 2618.
1873 *Trochus Nicobaricus.* P. Fischer in Kiener (32), vol. X, Turbo, p. 68, pl. 36, fig. 5 (*Turbo Nicobaricus* on the plate!).

1879 *Trochus (Chrysostoma) Nicobaricus.* P. Fischer, ibid., vol. XI, Trochus, p. 423.
1886 *Trochus (Chrysostoma) paradoxus.* Boog Watson, Challenger Gasterop. (8), p. 92.
1887 *Chrysostoma nicobaricum.* von Martens, Mergui (67), p. 197.
1889 — *paradoxum* Born. Pilsbry (109), vol. XI, p. 466; vol. X, pl. 45, figs. 91, 92.
1899 — — — Melvill and Standen, Torres Straits (77), p. 175.
1908 — — — Horst et Schepman (31), p. 478.
1908 — — — Schepman (104), p. 41.

Shore of Bali-strait, north of Banjuwangi, 1 specimen.

Distribution: East Indian Archipelago: Banka, Billiton, Borneo-bank (Strait of Makassar), Celebes, Saleyer, Paternoster Is. (Flores Sea), Flores, Timor, Banda, Kei Is., New Guinea. — Torres Straits, Admiralty Is. north of New Guinea, New Caledonia. — Cocos Is. (Indian Ocean, southwest of Java). — Philippines. — Singapore, Mergui Archipelago, Nicobars.

FAM. **NERITOPSIDAE.**

16. **Neritopsis radula** Linné sp..

1705 *Valvata granulata.* Rumphius (100), p. 78, pl. XXII, fig. M.
1758 *Nerita radula.* Linné, Systema Naturae, edit. X, p. 777.
1767 *Nerita radula.* Linné, Syst. Naturae, edit. XII, p. 1252.
(?1834) *Neritopsis cancellata.* Sowerby, Genera (105), Neritopsis, fig. 1.
1839 *Neritopsis granosa.* Sowerby, A Conchological Manual, p. 71, pl. 15, fig. 331.
1839 *Neritopsis radula.* Gray, Zoology of Beechey's voyage, p. 138.
1859 — — Chenu, Manuel (11), vol. I, p. 332, fig. 2407.
1875 — — Sowerby in Reeve (97), vol. XX, Vanikoro and Neritopsis, pl. III.
1888 — — Linn.. Tryon (109), vol. X, p. 82, pl. 29, fig. 68.

1889 *Neritopsis radula*. von Martens, Nerita u. Neritopsis (66), pp. 131—134, pl. A, figs. 15—20.
1902 — — L.. von Martens, Rumphius Gedenkboek (71), p. 115.
1907 — — - Couturier, Tahiti, etc. (13), p. 168.
1908 — — - Horst et Schepman (31), p. 436.

Coral-island Pulu Pandjang, 2 young specimens. Bantam (Favanne, 1780). Madura (Leyden Museum). Distribution: Timor, Moluccas.
— New Caledonia, Paumotu. — Singapore, Nicobars, Coromandel Coast, Ceylon, Mauritius, Réunion.

FAM. **NERITIDAE.**

17. **Nerita (Theliostyla) albicilla** Linné.

1705 *Valvata compressa*. Rumphius (100), p. 78.
— een rechte wydmond. Schynvoet in Rumphius (100), p. 79, pl. XXII, fig. 8.
1758 *Nerita albicilla*. Linné, Systema Naturae, edit. X, p. 778.
1767 — — Linné, Syst. Nat., edit. XII, p. 1254.
1788-'90 — — Gmelin, Syst. Nat. (27), p. 3681.
1822 — — Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 192, nr. 8.
1834 — — Quoy et Gaimard, Voyage de découvertes de l'Astrolabe (96), vol. III, p. 182, pl. 65, figs. 17, 18.
1838 — — Lamarck, An. s. vert. (53), vol. VIII, p. 605, nr. 8.
1844 *Nerita venusta*. Dunker in Philippi, Abbildungen (86), vol. I, p. 86; Nerita, pl. I, fig. 11.
1855 *Nerita albicilla*. Reeve (97), vol. IX, Nerita, species 64, pl. XV, figs. 64 a—d.
1869 — — Lischke, Japan. Meeresconch. (59), vol. I, p. 85 (exclusive of var. b).
1871 — — Lischke, ibid., vol. II, p. 81.
1874 — — Lischke, ibid., vol. III, p. 60.
1883 — — Sowerby, Thesaurus (106), vol. V, p. 112, Nerita, pl. II, figs. 26—28; pl. VI, fig. 113.
— — *ustulata*. Sowerby, ibid., pl. VI, fig. 122.
1887 *Nerita albicilla*. von Martens, Mergui (67), p. 194.

1887, 1889 *Nerita (Theliostyla) albicilla.* von Martens, Nerita u. Neritopsis (66), pp. 25, 124, pl. 8, figs. 1—2; pl. 3, figs. 1—4, 6—9.
1888 *Nerita (s. str.) albicilla* Linn.. Tryon (109), vol. X, p. 19, pl. 2, figs. 21—24.
1890 *Nerita albicilla.* O. Boettger (5), p. 169.
1891 — — O. Boettger (6), p. 309.
1895 — — Linné. Schepman, Borneo (102), p. 162.
1899 *Nerita (Thelicostyla) albicilla.* Melvill and Standen, Torres Straits (77), p. 174.
1901 *Nerita albicilla* Linné. H. Fischer, Djibouti, etc. (22*a*), p. 121.
1902 — — L. von Martens, Rumphius Gedenkboek (71), p. 115.
1908 *Nerita (Theliostyla) albicilla* and var. *venusta* Philippi. Horst et Schepman (31), p. 404.
1908 — — — Schepman (104), p. 3.

Shore of Bali-strait, north of Banjuwangi, 3 specimens.

Anjer, coast of Sunda-strait (von Martens). Pulu lang, Thousand Is., north of Batavia (Strubell). Reef Vader Smit, roadstead of Batavia (Strubell). Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Sumatra, Billiton, Borneo, Borneo-bank, Celebes and adjacent islands, Kangeang-island east of Madura, Lombok, Sumbawa, Flores, Sumba, Rotti, Timor, Lucipara-island, Banda, Amboina, Sula Is., Obi, Bachan, Waigeu, Aru Is., New Guinea.
— Torres Straits, Western Australia, North east coast of Australia, New Ireland, Solomon Is., New Caledonia, Viti Is., Tonga, Samoa, Tahiti. — Philippines, Formosa, Southern Japan, Hongkong, Singapore, Mergui-archipelago, Nicobars, Ceylon, Kathiawar (West coast of India), Persian Gulf, Aden, Jibuti (Somaliland), Perim-island (Museum Wageningen), Sokotra, East African coasts and islands, Natal.

According to von Martens this species does not occur in the Red Sea. Our specimen from Perim, collected by Mr. Kalshoven, is quite typical, consequently the species occurs at least in Bab-el-Mandeb Strait.

18. **Nerita (Theliostyla) reticulata** Karsten.

1789 *Nerita reticulata*. Karsten, Museum Leskeanum, vol. I, p. 296, nr. 1236, pl. 2, fig. 8.
1822 *Nerita signata*. Macleay in Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 195, nr. 17.
1828 *Nerita rudis*. W. Wood, Supplement to the Index Testaceologicus, pl. 8, fig. 13.
1838 *Nerita signata*. Lamarck, An. s. vert. (53), vol. VIII, p. 610, nr. 17.
— — *reticulata* Karst.. Deshayes in Lamarck, ibid., p. 610, nr. 18.
1850 — — Recluz in: Journal de Conchyliologie, vol I, p. 285.
1852 *Nerita (Theliostyla) petechialis* (Meuschen). Mörch, Catalogus Yoldi, p. 167.
1855 *Nerita signata* Macleay. Reeve (97), vol. IX, Nerita, pl. X, figs. 44 a, b.
1867 — — Mitchell, Catalogue of the Mollusca in the collection of the Government Central Museum, Madras, p. 30.
1887, 1889 *Nerita (Theliostyla) reticulata*. von Martens, Nerita u. Neritopsis (66), pp. 22, 124, pl. 5, figs. 1–4.
1888 *Nerita (s. str.) reticulata* Karsten. Tryon (109), vol. X, p. 21, pl. 3, fig. 49.
1899 *Nerita signata* Macleay. Melvill and Standen, Torres Straits (77), p. 174.
1908 *Nerita (Theliostyla) reticulata*. Horst et Schepman (31), p. 405.
1908 — — — Schepman (104), p. 4.

Coral-island Pulu Pandjang, 2 specimens.
Shore of Bali-strait, north of Banjuwangi, 2 specimens.
Anjer, coast of Sunda-strait (von Martens).
Distribution: East Indian Archipelago: Flores, Timor, Amboina, Ceram.
— Philippine Is.. — Jaluit (Marshall Is.), Gilbert Is., Solomon Is., Torres Straits, Western Australia.

The specimens are easily recognizable by the blood-red stain on the columellar area.

19. **Nerita (Theliostyla) chamaeleon** Linné.

1705 *Valvata tertia undulata.* Rumphius (100), p. 77, pl. XXII, fig. L.
– Schynvoet in Rumphius (100), p. 78, pl. XXII, figs. 5, 6.
1758 *Nerita Chamaelon.* Linné, Systema Naturae, edit. X, p. 779, nr. 644.
1767 — — Linné, Syst. Nat., edit. XII, p. 1255.
1781 *Nerita Chamaeleon Linnaei.* Chemnitz, Conchylien-Cabinet, vol. V, p. 310, pl. 192, figs. 1988—1991.
1788-'90 *Nerita Chamaeleon.* Gmelin, Syst. Nat. (27), p. 3682, nr. 49.
1795 *Nerita Stella.* Chemnitz, Conchylien-Cabinet, vol. XI, p. 174, pl. 197, figs. 1907, 1908.
1817 *Nerita chamaeleon.* Dillwyn, A descriptive Catalogue of recent shells, vol. II, p. 1003, nr. 57.
1822 — — Lamarck, An. s. vert. (52), vol. VI, 2nd part, pp. 192—193, nr. 9.
1838 — — Lamarck, An. s. vert. (53), vol. VIII, p. 606, nr. 9.
— — *stella* Chemn.. Deshayes in Lamarck, ibid., p. 610, nr. 19.
1841 – *squamulata.* Le Guillou in: Revue Zoologique, par la Société Cuvierienne, p. 344.
1841 – *modesta.* Hombron et Jacquinot, Voyage au Pôle Sud, pl. 16, figs. 5, 6.
1848 — *scabrella.* Philippi in: Zeitschrift für Malakozoologie, p. 14.
1850 — *chamaeleon.* Recluz in: Journal de Conchyliologie, vol. I, p. 286.
1854 — — var.. Rousseau in Hombron et Jacquinot, Voyage au Pôle Sud, p. 61.
1855 — — Hanley, Ipsa Linnaei Conchylia, p. 407, pl. 4, fig. 8.
1855 — *stella* Chemn.. Reeve (97), vol. IX, Nerita, pl. XIII, figs. 60 a, b, c, d.
— — *squamulata* Le Guill.. Reeve, ibid., pl. XV, figs. 63 a, b, c.
— — *annulata.* Reeve, ibid., pl. XVIII, figs. 78 a, b.
1878 *Nerita (Theliostyla) stella* Chemn.. Troschel, Das Gebiss der Schnecken, II, p. 195, pl. XVIII, fig. 2 (radula).

1883 *Nerita chamaeleon*. Sowerby, Thesaurus (106), vol. V, p. 111, Nerita, pl. V, figs. 95—97.
— — *squamulata*. Sowerby, ibid., p. 111, pl. II, figs. 24, 25; pl. VI, figs. 101, 102.
— — *annulata* Reeve. Sowerby, ibid., p. 112, pl. IV, fig. 75.
1887 *Nerita chamaeleo* L.. von Martens, Mergui (67), p. 194.
1887, 1889 *Nerita (Theliostyla) chamaeleon*. von Martens, Nerita u. Neritopsis (66), pp. 19—22, 108, 124, pl. 2, figs. 13—16; pl. 5, figs. 5—15.
1888 *Nerita (s. str.) chamaeleon* L.. Tryon (109), vol. X, p. 20, pl. 2, figs. 31—36; pl. 3, figs. 37, 39; pl. 6, fig. 4.
1889 *Nerita chamaeleon*. L. Morlet in: Journal de Conchyliologie, vol XXXVII, p. 157.
1891 — — P. Fischer, Indo-Chine (22), p. 198 (reprint, p. 114).
— — *stella*. P. Fischer, ibid., p. 198 (114).
1895 — — *chamaeleo* Linné. Schepman, Borneo (102), p. 162.
— — *squamulata* Le Guillou. Schepman, ibid., p. 162.
1902 *Nerita chamaeleo* L.. von Martens, Rumphius Gedenkboek (71), p. 115.
1905 *Nerita chamaeleon*. Dautzenberg et H. Fischer, Tonkin (17), pp. 177—179.
1905 *Nerita (Theliostyla) chamaeleon* L., var. *squamulata* Le Guill.. K. Martin, Foss. von Java (73), p. 272, pl. XL, figs. 654, 655.
1908 — — — and vars. *squamulata* Recluz and *annulata* Reeve. Horst et Schepman (31), pp. 405—406.
1908 — — — and var. *squamulata* Guillou. Schepman (104), p. 4.
1911 — — — H. Martin–Icke, Trinil (76), pp. 47, 48.
1919 *Nerita chamaeleon* Linn., var. *squammulata* Le Guill.. K. Martin (75), pp. 101, 142.
1920 — — L.. Tesch, Timor (108), II, p. 73, pl. CXXXIII, figs. 213 a, b.

Shore of Bali-strait, north of Banjuwangi, 2 specimens.

One specimen belongs to the typical form, the other to the form *squamulata* Le Guillou.

Tjilatjap (Leyden Museum). Palabuan, Wijnkoopsbay (von Martens).

Distribution: East Indian Archipelago: Sumatra, Riouw, Sambas (Borneo), Celebes, Talaut-islands N. E. of Celebes, Sumbawa, Flores, Timor, Amboina, Ternate, Halmahera, Aru Is., New Guinea.

— Northern Australia, Port Denison (Queensland), Solomon Is., Viti Is., Samoa. — Philippines, Hongkong, Tongking, Gulf of Siam, Singapore, Mergui-archipelago, Nicobars, Vizagapatam (East coast of India).

Fossil in the Pliocene of Java and Timor.

Though this species is very variable, specimens are always characterized by the concave columellar area.

20. **Nerita** (**Cymostyla**) **undata** Linné.

1758 *Nerita undata*. Linné, Systema Naturae, edit. X, p. 779.
1767 — — Linné, Syst. Nat., edit. XII, p. 1255.
1830 *Nerita Novae-Guineae*. Lesson, Voyage autour du monde, exécuté sur la corvette de S. M. la Coquille, pendant les années 1822—'25; Zoologie, vol. II, p. 371.
1838 *Nerita undata* Lin.. Deshayes in Lamarck, An. s. vert. (53), vol. VIII, p. 616, nr. 27.
1841 *Nerita Papuana*. Recluz in: Revue Zoologique, par la Société Cuvierienne, p. 105.
1841 *Nerita marmorata*. Hombron et Jacquinot, Voyage au Pôle Sud; Moll., pl. 16, figs. 14—17.
1842 *Nerita Le-Guillouana*, Recluz in: Revue Zoologique, par la Société Cuvierienne, p. 178.
1850 *Nerita undata*. Recluz in: Journal de Conchyliologie, vol. I, p. 283.
— — *Le-Guillouana*. Recluz, ibid., p. 284.
— — *Novae-Guineae*. Recluz, ibid., p. 283.
1855 *Nerita Le-Guillouana* Recluz. Reeve (97), vol. IX, Nerita, pl. IV, fig. 15 a.
— — *Savieana* (Recluz M. S.). Reeve, ibid., pl. VIII, figs. 37 a, b.
— — *Novae-Guineae* Lesson. Reeve, ibid., pl. XIII, figs. 59 a, b.

1855 *Nerita undata*. Hanley, Ipsa Linnaei Conchylia, p. 407.
1883 — — Gmelin. Sowerby, Thesaurus (106), vol. V, p. 115, species 61, Nerita, pl. I, fig. 5.
— — *Novae-Guineae* Lesson. Sowerby, ibid., p. 108, spec. 20, Nerita, pl. IV, fig. 78.
1887, 1889 *Nerita (Cymostyla) undata*. von Martens (66), pp. 34—37, 110—111, 124, pl. 6, figs. 10—14, 16.
1888 *Nerita (Pila) undata* Linn.. Tryon (109), vol. X, p. 28, pl. 5, figs. 87, 88, 90.
1895 *Nerita striata*. Schepman, Borneo (102), p. 162.
1899 *Nerita undata*. Melvill and Standen, Torres Straits (77), p. 174.
1901 — — L.. H. Fischer, Djibouti, etc. (22*a*), p. 121.
1908 *Nerita (Cymostyla) undata*. Horst et Schepman (31), p. 408.
1908 — — — Schepman (104), p. 5.
1919 *Nerita undata*. K. Martin (75), p. 101.

Coral-island Pulu Pandjang, 1 young specimen, greyish mottled with black.
Shore of Bali-strait, north of Banjuwangi, 1 specimen, blackish waved with grey (as Reeve's figure of *N. Savieana*).

Distribution: East Indian Archipelago: Banka, Billiton, Sambas (Borneo), Celebes, Lombok, Flores, Tanah-Djampeah (Flores Sea), Timor, Banda, Amboina, Ternate, Misol, New Guinea.
- Torres Straits, New Britain, New Ireland, Solomon Is., Viti Is..
- Philippines, Japan, Hongkong, Gulf of Siam. — Jibuti (Somaliland). — Nossi Faly near Madagascar.

Fossil in the Upper Miocene of Java (Preanger).

Forma **striata** Burrow.

1815 *Nerita striata*. Burrow, Elements of Conchology, p. 172, pl. 20, fig. 8.
1841 — *Tongaensis*. Hombron et Jacquinot, Voyage au Pôle Sud; Moll., pl. 16, fig. 18.
1841 — *chrysostoma*. Recluz in: Revue Zoologique, par la Société Cuvierienne, p. 104 (in part).
1842 — *aurantia*. Recluz in: Revue Zool., p. 1. Soc. Cuv., p. 43.

1844 *Nerita costulata*. von dem Busch in: Philippi, Abbild. (86), vol. I, p. 86, Nerita, pl. I, fig. 8.
1850 — *aurantia*. Recluz in: Journal de Conchyliologie, vol. I, p. 283, pl. 11, fig. 11.
1855 — *chrysostoma* Recluz. Reeve (97), vol. IX, Nerita, pl. IV, figs. 18 a, b.
— — *aurantia* Recluz. Reeve, ibid., pl. XI, figs. 49 a, b.
— — *grisea*. Reeve, ibid., species 23, pl. V, figs. 19 a, b.
1871 — *undata* L. var.. von Martens und Langkavel, Donum Bismarckianum, p. 43.
1883 — *chrysostoma* Recluz. Sowerby, Thesaurus (106), vol. V, p. 116, species 63, Nerita, pl. II, fig. 35.
1887, 1889 *Nerita (Cymostyla) striata* Burrow. von Martens, Nerita u. Neritopsis (66), pp. 37—39, 43, 111, 124, pl. 7, figs. 1—5.
1888 *Nerita (Pila) undata* L., var. *striata* Burrow. Tryon (109), vol. X, p. 28, pl. 5, figs. 91—93.
1908 *Nerita (Cymostyla) striata*. Horst et Schepman (31), p. 408.
1908 — — — Schepman (104), p. 6.

Shore of Bali-strait, north of Banjuwangi, 1 young specimen. The black spots and waves are predominating, so as almost to obscure the greyish ground-colour.

Distribution: East Indian Archipelago: Banka, Timor, Banda, Amboina, Celebes, Talaut-islands N. E. of Celebes, New Guinea.
— Philippines, Singapore, Ceylon, Bombay, Mauritius.
— Viti Is., Tonga, Samoa, Tahiti.

Though von Martens (66) deals with *Nerita striata* as a distinct species, he declares (l.c., p. 42): „*Nerita undata, striata, Spengleriana* und *quadricolor* sind nicht nur unter sich recht ähnlich, sondern auch durch einzelne Zwischenformen fast untrennbar verbunden, so dass man strenggenommen sie als Varietäten Einer Art betrachten müsste; ich habe das nur deshalb nicht gethan, weil die Mehrzahl der Exemplare, auch mit Rücksicht auf die Fundorte, sich noch deutlich auseinander halten lässt."

It is evident, that under these circumstances *Nerita siriata* cannot stand as a species. As there does not seem to be any difference in the geographical distribution of *N. undata* and *N. striata*, I cannot regard *N. striata* even as a subspecies, so I am compelled to consider it merely as a form of *Nerita undata*.

21. **Nerita (Pila) plicata** Linné.

1758 *Nerita plicata*. Linné, Systema Naturae, edit. X, p. 779.
1767 — — Linné, Systema Naturae, edit. XII, p.1255.
1771 *Nerita lactaria*. Linné, Mantissa plantarum altera, p. 551.
1788-'90 *Nerita plicata*. Gmelin, Syst. Nat. (27), p. 3681, nr. 47.
1822 — — Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 194, nr. 15.
1830 *Nerita Otaitensis*. Lesson, Voyage autour du monde, exécuté sur la corvette de S. M. la Coquille, pendant les années 1822—'25; Zoologie, vol. II, 1, p. 370.
1834 *Nerita versicolor*. Quoy et Gaimard, Voyage de découvertes de l'Astrolabe (96), vol. III, p. 186, pl. 65, figs. 23—26.
1838 *Nerita plicata*. Lamarck, An. s. vert. (53), vol. VIII, p. 609, nr. 15.
1855 — — Reeve (97), vol. IX, Nerita, pl. IX, figs. 42 a, b, c, d.
1855 — — Hanley, Ipsa Linnaei Conchylia, p. 406.
1887, 1889 *Nerita (Pila) plicata*. von Martens, Nerita u. Neritopsis (66), pp. 63—67, 112, 124, pl. 10, figs. 6—12.
1888 — — — Linn.. Tryon (109), vol. X, p. 27, pl. 5, figs. 81, 82.
1899 *Nerita (Peleronta) plicata*. Melvill and Standen, Torres Straits (77), p. 174.
1902 *Nerita plicata* L.. von Martens, Rumphius Gedenkboek (71), p. 115.
1907 — — — Couturier, Tahiti, etc. (13), p. 168.
1908 *Nerita (Pila) plicata*. Horst et Schepman (31), p. 409.
1908 — — — Schepman (104), p. 6.
1919 *Nerita plicata*. K. Martin (75), p. 101.

Tji Solok, Wijnkoopsbay. The only specimen is whitish without spots. The interstices of the ribs are pinkish white, becoming more pink towards the end of the last whorl; the ribs are white.

Palabuan, Wijnkoopsbay (von Martens).

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Kangeang-island (east of Madura), Lombok, Tanah-Djampeah (Flores Sea), Flores, Adonara, Rotti, Timor, Roma, Banda, Amboina, Ceram, Tawali near Bachan, Tidore, Ternate, Northern Celebes and islands N. E. of Celebes, Morotai, Misol, Aru Is., New Guinea.

— North Western Australia, Torres Straits, New Caledonia, Viti Is., Samoa, Tahiti, Paumotu, Marshall Is., Caroline Is., Marianne Is., Philippines, Formosa, Japan, Hongkong, Nicobars, Coromandel Coast, Ceylon, East African coasts and islands, Natal.

Fossil in the Upper Miocene of Java (Preanger).

This species lives on reefs and shores at low-water level and somewhat higher.

22. **Nerita (s. str.) polita** Linné.

1705 *Valvata striata prima sive alpina.* Rumphius (100), p. 77, pl. XXII, fig. I.
— — *secunda sive fasciata.* Rumphius, ibid., fig. K.
— Schynvoet in Rumphius, ibid., pl. XXII, figs. 2, 7.
1758 *Nerita polita.* Linné, Systema Naturae, edit. X, p. 778.
1767 — — Linné, Syst. Nat., edit. XII, p. 1254.
1781 *Nerita pennata.* Chemnitz, Conchylien-Cabinet, vol. V, p. 320, pl. 193, figs. 2011, 2012.
— — *nigra duplici fascia* etc.. Chemnitz, ibid., p. 321, pl. 193, fig. 2015.
— — *larva.* Chemnitz, ibid., p. 322, pl. 193, fig. 2017.
— — *hieroglyphica.* Chemnitz, ibid., p. 322, pl. 193, figs. 2016, 2018.
1789 — *florescens.* Chemnitz, Conchylien-Cabinet, vol. X, pp. 303, 304, 424, pl. 165, figs. 1594, 1595.
1788-'90 *Nerita bifasciata.* Gmelin, Syst. Nat. (27), p. 3685, nr. 26.
— — *larva.* Gmelin, ibid., p. 3679.
— — *litterata.* Gmelin, ibid., p. 3685.
— — *bidens* var. *β.* Gmelin, ibid., p. 3679.
1822 *Nerita polita.* Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 192, nr. 7.
1834 *Nerita polita.* Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, p. 189, pl. 65, fig. 31.

1834 *Nerita doreyana*. Quoy et Gaimard, ibid., p. 190, pl. 65, figs. 43, 44.
1838 *Nerita polita*. Lamarck, An. s. vert. (53), vol. VIII, pp. 604—605, nr. 7.
1841 *Nerita polita*. Hombron et Jacquinot, Voyage au Pôle Sud; Moll., pl. 16, figs. 21, 22.
— — *Vitiensis*. Hombron et Jacquinot, ibid., pl. 17, figs. 3—5.
1841 — *Orbignyana*. Recluz in: Revue Zoologique, par la Société Cuvierienne, 1841, p. 108.
— — *Rumphii*. Recluz, ibid., p. 147.
1850 — *polita*. Recluz in: Journal de Conchyliologie, vol. I, p. 282.
— — *Orbignyana*. Recluz, ibid., p. 282.
1852 *Nerita nigra*. Mörch, Catalogus Yoldi, p. 168.
— — *hieroglyphica*. Mörch, ibid., p. 168.
— — *flavescens*. Mörch, ibid., p. 168.
— — *flava* (Meuschen). Mörch, ibid., p. 168.
1855 *Nerita polita*. Reeve (97), vol. IX, Nerita, species 2, pl. I, figs. 2 a—d.
— — *Orbignyana*. Reeve, ibid., spec. 58, pl. XIII, figs. 58 a, b.
— — *Rumphii*. Reeve, ibid., spec. 62, pl. XIV, figs. 62 a—k.
1855 *Nerita polita*. Hanley, Ipsa Linnaei Conchylia, p. 403.
1858 *Nerita lineolata*. Gray in: Annals and Magazine of Natural History, p. 66.
1858 — — Gray in: Proceedings Zoological Society, p. 94.
1883 *Nerita polita*. Sowerby. Thesaurus (106), vol. V, p. 105, species 1, Nerita, pl. I, figs. 2, 3.
— — *Orbignyana*. Sowerby, ibid., p. 106, spec. 6, pl. III, figs. 48, 49.
— — *Rumphii* and var. *argus* Recl.. Sowerby, ibid., p. 106, spec. 5, pl. I, figs. 8—11, pl. VI, fig. 103.
1887 *Nerita polita*. von Martens, Mergui (67), p. 194.
1888 *Nerita (Odontostoma) polita* and var. *Rumphii*. Tryon (109), vol. X, pp. 30, 31, pl. 6, figs. 7—11; pl. 7, figs. 12—16, 19—20, 23.
1888, 1889 *Nerita (s. str.) polita* and var. *Rumphii*. von Martens, Nerita u. Neritopsis (66),

pp. 72—81, 124, pl. 3, figs. 5, 10—15; pl. 14, figs. 1—13.

1890 *Nerita polita*. O. Boettger (5), pp. 169—170.

1891 — — O. Boettger (6), p. 310.

1899 — — Melvill and Standen, Torres Straits (77), p. 173.

1899 — — Dautzenberg, Sumatra (15), p. 4.

1901 *Nerita rumphii* Recluz. H. Fischer, Djibouti, etc. (22*a*), p. 121.

1903 *Nerita (Odontostoma) polita* L. var. *rumphii* Recl.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 264, 280—281.

1907 *Nerita polita* L.. Couturier, Tahiti, etc. (13), p. 168.

1908 *Nerita (Tenare) polita*; variété intermédiaire de l'espèce et de la variété *Rumphii* and var. *Rumphii*. Horst et Schepman (31), pp. 410—411.

1908 *Nerita polita* and var. *Rumphii*. Schepman (104), p. 7.

1909 *Nerita polita*, var. *Rumphii*. Lamy, Java (56), p. 467.

1911 *Nerita (Tenare) polita*. H. Martin–Icke, Trinil (76), p. 47.

1919 *Nerita polita*, var. *Rumphii*. K. Martin (75), p. 101.

1923 *Nerita (Odontostoma) polita* L. var. *rumphii* Recl.. Henrich, Meeresmoll. Sinai (28*a*), p. 73.

Coral-island Pulu Pandjang, 1 specimen. Pinkish grey with 3 darker bands formed by small black spots, in general appearance somewhat like fig. 2 c of Reeve, the dark bands however not being reddish as in Reeve's figure.

The specimen may be assigned to the form *rumphii*, but it is not a typical representative of this form, the spiral striae being distinct on the earlier whorls only. For the rest the existence of many transitional forms between *N. polita* and *N. rumphii* proves the very small systematic value of the latter.

Other Javanese localities: Pulu lang, Thousand Is. north of Batavia (Strubell). Anjer, coast of Sunda-strait (von Martens). Tjilatjap (Leyden Museum).

Distribution of *Nerita polita* (inclusive of *N. rumphii*): East Indian Archipelago: Sumatra, Banka, Billiton, Palos-bay (Celebes), Lombok, Sumbawa, Flores, Adonara, Timor, Roma, Lucipara-island, Banda, Amboina, Ceram, Bachan, Ternate, Halmahera, Waigeu, Aru Is., New Guinea.

— Torres Straits, New Ireland, Solomon Is., Viti Is., Tonga, Samoa, Paumotu, Hawaii. — Norther Queensland, Western Australia, South coast of Australia. — Philippines, Southern China: near Canton and Hongkong, South China Sea, Gulf of Siam, Singapore, Salang, Mergui Archipelago, Nicobars, Andamans, Madras, Ceylon, Persian Gulf, South coast of Arabia, Jibuti (Somaliland), Red Sea, Gulf of Suez, Gulf of Akabah, East African coasts and islands, Natal, Table Bay (Cape of Good Hope).

Fossil in the Miocene and Pliocene of Java.

Nerita polita lives on rocks, that are covered by the sea only for a short time at high tide.

23. **Nerita (Amphinerita) insculpta** Recluz.

1841 *Nerita insculpta*. Recluz in: Revue Zoologique, par la Société Cuvierienne, p. 152.
— — *Listeri*. Recluz, ibid., p. 177.
— — *georgina*. Recluz, ibid., p. 180.
1841 *Nerita arcta*. Hombron et Jacquinot, Voyage au Pôle Sud; Moll., pl. 16, figs. 12, 13.
1850 *Nerita insculpta*. Recluz in: Journal de Conchyliologie, vol. I, p. 282.
— — *georgina*. Recluz, ibid., p. 282, pl. 11, fig. 10.
— — *Pacifica*. Recluz, ibid., p. 283 (no figure!).
1852 *Nerita georgina*. Souleyet, Voyage de la Bonite (20), vol. II, p. 566, pl. 34, fig. 5.
1854 *Nerita arcta*. Rousseau in Hombron et Jacquinot, Voyage au Pôle Sud; Moll., p. 62.
1855 *Nerita Georgina* Recluz. Reeve (97), vol. IX, Nerita, pl. XVII, figs. 74 a, b.
1874 *Nerita Birmanica* (Phil.) var. *minor*. Dunker, Catalog d. Mus. Godeffroy, V, p. 144; VI, p. 90.
— — *Hilleana*. Dunker, ibid., V, p. 145.
1888 *Nerita (Odontostoma) Georgina* Recl.. Tryon (109), vol. X, p. 33, pl. 7, fig. 31.
— — — *arcta* Hombr. and Jacq.. Tryon, ibid., p. 34, pl. 9, figs. 64, 65.
1888, 1889 *Nerita (Amphinerita) insculpta* Recl.. von Martens, Nerita u. Neritopsis (66), pp. 88—91, 124, pl. 11, figs. 1—4.

1891 *Nerita insculpta* Recl.. P. Fischer, Catal. Indo-Chine (22), p. 199 (reprint, p. 115).
1899 *Nerita Georgina* Recluz. Dautzenberg, Sumatra (15), p. 4.
1905 *Nerita insculpta* Recl.. Dautzenberg et H. Fischer, Tonkin (17), pp. 176—177.
1908 *Nerita (Amphinerita) insculpta* Recluz and vars. *arcta* Hombr. et Jacq. and *pacifica* Recl.. Horst et Schepman (31), p. 412.
1908 *Nerita insculpta* Recl. var. *arcta* Hombr. et Jacq.. Schepman (104), p. 8.
Not *Nerita Listeri* (*not* of Recluz) Reeve, figs. 36 a, b.

Tji Solok, Wijnkoopsbay, 1 specimen, belonging to the form *arcta* Hombr. et Jacq.. It agrees fairly well with the description of a specimen from Misol by Schepman. The colour is somewhat darker than in the figures of von Martens, but there are only very slight indications of teeth on the columellar margin. There are also some intermediate ribs on the basal zone of the last whorl, the total number of ribs at the outer margin amounts to 35.

Height: $12^1/_2$, maximum diameter: 14 millimetres.

Mantjingan, south coast of Resid. Jokjakarta, 1 specimen. As it is rather dark coloured and the columellar margin has more distinct teeth, it may be assigned to the form *pacifica* Recluz, though the last whorl is much deflected in front and consequently the shell is higher than usual.

Height: 15, maximum diameter: 14 millimetres.

At the outer margin the number of ribs amounts to about 36.

Distribution: East Indian Archipelago: Between Padang and Indrapura (West Coast of Sumatra), Flores, Timor, Amboina, Ceram, Ternate, Halmahera, Morotai, Misol, Aru Is.. — Malacca, Annam, Tongking (in brackish water), Philippines.
— King George Sound (south coast of Western Australia), Port Denison (Queensland), Samoa.

24. **Neritina (Dostia) crepidularia** Lamarck.

1822 *Neritina crepidularia*. Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 186, nr. 10.

1836 *Neritina cornucopia*. Benson in: Journal of the Asiatic Society of Bengal, V, p. 748.
— — *depressa*. Benson, ibid., p. 748.
1837 *Neritina melanostoma*. Troschel in: Archiv für Naturgeschichte, Jahrg. III, p. 179.
1838 *Neritina crepidularia*. Lamarck, An. s. vert. (53), vol. VIII, p. 572, nr. 10.
— — *violacea*. Deshayes in Lamarck, ibid., p. 580, nr. 25.
1842 *Nerita Indica*. Souleyet in: Revue Zoologique, p. 269.
— — *Touranensis*. Souleyet, ibid., p. 269.
1843 *Neritina Siquijorensis*. Recluz in: Proceedings Zoological Society London, p. 198.
1843 *Neritina melanostoma* Tr.. Philippi, Abbild. (86), vol. I, Neritina, pl. I, fig. 11.
1849 *Neritina crepidularia* Lamarck. Sowerby, Thesaurus (106), vol. II, p. 509, nr. 9, pl. CXIII, figs. 139—144.
— — *depressa* Benson. Sowerby, ibid., p. 510, nr. 11, pl. CXIII, figs. 147—148.
— — *Siquijorensis* Recluz. Sowerby, ibid., p. 510, nr. 12, pl. CXIII, figs. 145—146.
1850 *Neritina crepidularia* Lk.. Recluz in: Journal de Conchyliologie, vol. I, pp. 60, 69.
— — *violacea* Gm.. Recluz, ibid., p. 67.
— — *melanostoma* Tr.. Recluz, ibid., p. 70.
— — *touranensis*. Recluz, ibid., p. 71.
— — *exaltata*. Recluz, ibid., p. 65, pl. III, fig. 3.
— — *pileolus*. Recluz, ibid., p. 66.
1851 *Neritina crepidularia* Lk.. Metcalfe in: Proceedings Zoological Society of London, p. 72.
1852 *Nerita Tourannensis*. Souleyet, Voyage de la Bonite (20), vol. II, p. 570, pl. 34, figs. 28—31.
— *melanostoma* Tr.. Souleyet, ibid., p. 571, pl. 34, figs. 32—35. („Nérite indienne" on the plate!).
1853 *Neritina crepidularia*. Metcalfe in: Annals and Magazine of Natural History, 2nd series, vol. XI, p. 69.
1855 *Neritina Crepidularia*. Reeve (97), vol. IX, Neritina, pl. VIII, figs. 38 a, b.
— — *depressa* Benson. Reeve, ibid., pl. XVIII, figs. 86 a, b.
1856 — *Siquijorensis* Recluz. Reeve, ibid., pl. XXVII, figs. 119 a, b.

1867 *Neritina (Dostia) depressa* Bens.. Blanford in: Journal of the Asiatic Society of Bengal, vol. XXXVI, part 2, p. 60, pl. XII, figs. 17—19.
— — — *cornucopia* Bens.. Blanford, ibid., p. 60, pl. XII, figs. 23—25.
— — — *crepidularia*. Blanford, ibid., p. 60, pl. XII, figs. 20—22.
1872 *Neritina cornucopia*. Morelet in: Journal de Conchyliologie, vol. XX, p. 137.
— — *violacea* Gm.. Morelet, ibid., pp. 133, 137.
1874 *Neritina (Mitrula) Schläflii*. Mousson in: Journ. d. Conch., vol. XXII, p. 49.
1874 *Neritina (Dostia) crepidularia* Lk.. Issel, Molluschi Borneensi, pp. 106, 108.
— — — *cornucopiae* Bens.. Issel, ibid., p. 108.
1875 *Neritina violacea* Gm.. Morelet, Séries Conchyliologiques, livrais. IV, pp. 322—327.
— — *cornucopia* Bens.. Morelet, ibid., p. 325.
1875, 1879 *Neritina (Neritaea) crepidularia* Lam.. von Martens, Neritina (64), pp. 37—45, 276—277, pl. 7, figs. 1—14.
1882 *Neritina crepidularia* Lam.. E. A. Smith, Freshw. shells of Australia (104ter), p. 297.
1887 *Neritina (Dostia) crepidularia* Lam.. von Martens, Mergui (67), p. 171.
1888 — — — — Tryon (109), vol. X, p. 77, pl. 23, figs. 95—99.
1889 *Neritina violacea* Gmel.. L. Morlet in: Journ. de Conch., vol. XXXVII, p. 157.
— — *cornucopiae* Bens.. L. Morlet, ibid., p. 158.
1890 *Neritina(Dostia) crepidularia*. O. Boettger (5), p. 162.
1891 — — *violacea* Gm.. P. Fischer, Catal. Indo-Chine (22), p. 200 (reprint, p. 116).
— — — *depressa* Bens.. P. Fischer, ibid., p. 200 (116).
— — — *cornucopia* Bens.. P. Fischer, ibid., p. 200 (116).
1897 — *crepidularia*. von Martens (69), pp. 218, 306.
1898 — — P. u. F. Sarasin, Süssw.-Moll. Celebes (101), p. 70.

1903 *Neritina (Dostia) crepidularia*, Lam.. Dautzenberg, Sambas (16*a*), p. 7.
1904 — *violacea* Gm.. H. Fischer et Dautzenberg, Catal. Indo-Chine in: Mission Pavie; Etudes diverses, III, p. 434 (p. 45 of reprint).
— — *(Dostia) depressa* Bens.. H. Fischer et Dautzenberg, ibid., p. 434 (45).
— — — *cornucopia* Bens.. H. Fischer et Dautzenberg, ibid., p. 434 (45).
1905 — *(Dostia) violacea* Gmelin. Dautzenberg et H. Fischer, Tonkin (17), pp. 182—186.
1906 — — — — and var. *melanostoma* Troschel. Dautzenberg et H. Fischer, Indo-Chine (18), pp. 447, 448.
1908 — *(Neritaea) crepidularia* and vars. *cornucopiae* Benson and *exaltata* Recluz. Horst et Schepman (31), p. 415.
— — — *siquijorensis* Recluz. Horst et Schepman, ibid., p.416.
1908 — — *crepidularia*, var. *exaltata* Recl.. Schepman (104), p. 9.
1914 — *crepidularia*. Leschke, Java und Celebes (58), p. 263.
1919 *Dostia cornucopia* (Benson). Annandale and Prashad, Gangetic Delta (2), p. 242, pl. XX, fig. 2 a.
— — *depressa* (Benson). Annandale and Prashad, ibid., pp. 243, 244, pl. XX, fig. 2 b.
1921 *Neritina (Dostia) crepidularia*, var. *melanostoma* (Tr.) and *exaltata* (Recl.). Prashad, Sumatra (95), pp. 498, 499.

Surabaya, shore of Bandjaran, 2 specimens. One specimen belongs to the form *exaltata* Recl., it has 12 teeth on the columellar margin and a reticulated colour-pattern, unfortunately the peristome is bleached. The other specimen is in no better condition, it

seems to be somewhat intermediate between the forms *exaltata* and *cornucopia* Bens. as distinguished by von Martens, the number of teeth is about 9. Coast near mouth of river Tji Lamaja, 1 specimen of the form *exaltata* with red-coloured peristome.

Maximum diameter: 19; height of the aperture: $13^1/_2$ millimetres.

Tandjong Priok near Batavia (Strubell). River Kali Mas near Surabaya (Leyden Museum). Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Sumatra: Palembang, mangrove-swamps at Belawan (Deli); Banka; Borneo; Makassar (Celebes); Bali; Timor; Mac Cluer Gulf, New Guinea; **not** recorded from the Moluccas.
— Port Essington (Northern Australia); Swan River, Western Australia; Northern Queensland.
— Philippines; Yokohama, Japan. — Tongking, in brackish water in the Delta-region; Annam; river Mekong in Lower Cochin-China; Cambodia; Bangkok, also in fresh water; Patani river on the east coast of the Malay Peninsula; Singapore; Mergui-archipelago, on mud-flats and sand-flats; Irrawady Delta (Burma); Gangetic Delta; Coromandel Coast; Ceylon; Calicut (Malabar Coast), in swampy pools; Persian Gulf. — ? Natal (S. Africa).

Neritina crepidularia occurs chiefly in brackish water, but it lives also in fresh or almost fresh water near the upper limits of tidal influence.

25. **Septaria suborbicularis** Sowerby sp..

1705 *Nootedoppen.* Rumphius (100), p. 123, pl. XL, fig. O.
1825 *Navicella suborbicularis.* Sowerby, Catalogue of the shells of Earl Tankerville; appendix, p. X.
1855 — — Sowerby, Thesaurus (106), vol. II, p. 551, pl. 108, figs. 30, 31.
1856 — *orbicularis* (Sowerby). Reeve (97), vol. IX, Navicella, pl. II, figs. 5 a, b, c.
1881 — *suborbicularis.* von Martens, Navicella (65), pp. 31—34, pl. 6, figs. 5—14.
1888 *Navicella (Elara) suborbicularis.* Tryon (109), vol. X, p. 81, pl. 29, figs. 44—46.

1897 *Septaria suborbicularis*. von Martens (69), pp. 84—85, 307.
1898 — — P. und F. Sarasin, Süsswassermoll. Celebes (101), p. 72.
1902 *Septaria (Navicella) suborbicularis*. von Martens, Rumphius Gedenkboek (71), p. 124.
1908 *Septaria suborbicularis*. Horst et Schepman (31), p. 435.
1908 — — Schepman (104), p. 14.
1912 — — Schepman (103), p. 238.
1914 — — Leschke, Java und Celebes (58), pp. 265—266.

Tji Solok, Wijnkoopsbay, 1 specimen, rather worn, belonging to the typical form.

Near Palabuan at the Wijnkoopsbay (von Martens). Nusa Kambangan (Jacobson). River Bomo (Kali Båmå), southward of Banjuwangi, East-Java (Zollinger).

Distribution: East Indian Archipelago: Sumatra, Lombok (in rivers), Flores (in rivers), Adonara, Solor Is., Sumba, Timor, brook at Amboina, Ceram. Pulu Kelang west of Ceram, Ternate, Northern Celebes, Togean Is. near Celebes, New Guinea. — New Hanover near New Guinea. — Philippines (in rivers and rivulets). Singapore. Nicobars, Andaman Is., Ceylon. The locality „Iles Marquises" (specimens from the Cuming collection in the Leyden Museum) is at least very doubtful.

According to von Martens this species is confined to fresh water; it was never found in brackish water by that author.

FAM. **TURRITELLIDAE.**

26. **Turritella (s. str.) terebra** Linné sp..

1705 *Strombus tympanorum. Tympanotonos*. Rumphius (100), p. 100, pl. XXX, fig. M.
1767 *Turbo terebra*. Linné, Systema Naturae, edit. XII, p. 1239 (*not* of Fauna Suecica).
1817 *Turritella Archimedes*. Dillwyn, A descriptive Catalogue of recent shells, vol. II, p. 871, nr. 135.
1843 *Turritella terebra*. Lamarck, An. s. vert. (53), vol. IX, p. 252.
1843-'44 — — Kiener (32), vol. X, Turritella, p. 4, pl. 3, fig. 1.

1849 *Turritella terebra*. Reeve (97), vol. V, Turritella, pl. I, fig. 3.
1884 — — K. Martin, Tiefbohr. Java (72), p. 171.
1886 — — Tryon (109), vol. VIII, p. 195, pl. 59, fig. 32.
1897 *Turritella (s. str.) terebra*. Kobelt, Turritella (36), p. 29, pl. 7, fig. 2.
1899 — — — Horst et Schepman (31), p. 242.
1902 *Turritella terebra* L.. von Martens, Rumphius Gedenkboek (71), p. 120.
1905 *Turritella terebra*, var.. K. Martin, Foss. v. Java (73), p. 232, pl. XXXV, fig. 548.
1907 — — L.. Schepman, Posttertiär Celebes (102*a*), p. 190.
1909 *Turritella (s. str.) terebra*. Schepman (104), p. 186.
1919 *Turritella terebra*, var.. K. Martin (75), pp. 96, 124, 134, 145.

Coast near mouth of river Tji Lamaja, 1 specimen. Surabaya, Harbour, mud, 3 specimens.

Near „Zwaantjes-droogte", Madura-strait (Siboga expedition).

Distribution: Indrapura, West coast of Sumatra (Museum Wageningen), Riouw-archipelago, West coast of Borneo, Amboina, Ceram.

— Singapore, Philippines, China. — Indian Ocean.

Fossil in quaternary deposits at Batavia and Semarang and in the Minahassa (Northern Celebes). A somewhat deviating form in the Upper Miocene of East-Java.

27. **Turritella (s. str.) cingulifera** Sowerby.

1825 *Turritella cingulifera*. Sowerby, A Catalogue of the shells contained in the collection of the late Earl of Tankerville; Appendix, p. XIV.
1843-'44 *Turritella fragilis*. Kiener (32), vol. X, Turritella, p. 34, pl. 8, fig. 3.
1849 *Turritella cingulifera*. Reeve (97), vol. V, Turritella, pl. XI, fig. 64.
1877 *Torcula parva*. Angas in: Zoolog. Proceedings, p. 174, pl. 26, fig. 17.
1884 *Turritella vulgaris*. K. Martin, Tiefbohr. Java (72), pp. 172—173, 308, pl. 9, fig. 167.

1886 *Turritella cingulifera*. Tryon (109), vol. VIII, p. 198, pl. 59, figs. 38, 39, 41.
1887 — — von Martens, Mergui (67), p. 192.
1897 *Turritella (Haustator) cingulifera*. Kobelt, Turritella (36), p. 23, pl. 5, fig. 11.
1897 *Turritella (s. str.) fragilis*. Kobelt, ibid., p. 33, pl. 8, figs. 7, 8.
1903 *Turritella cingulifera* Sow.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 257, 278—279.
1905 — — K. Martin, Foss. v. Java (73), p. 233.
1909 *Turritella (s. str.) cingulifera*. Schepman (104), p. 187.
1911 *Turritella cingulifera*. H. Martin–Icke, Trinil (76), p. 47.
1919 — — K. Martin (75), pp. 96, 124, 125, 138.
1920 — — Tesch, Timor (108), II, p. 61, pl. CXXXII, fig. 193.

Coast near mouth of river Tji Lamaja, many specimens.

Near reef of Batjulmati, East coast (Siboga expedition).

Madura-strait (Siboga exp.).

Distribution: Widely spread throughout the eastern part of the Indian Archipelago: Borneo-bank (Strait of Makassar), Celebes and adjacent isles, Talaut Is. (N. E. of Celebes), Sumbawa, Flores, Flores Sea, Adonara, Sumba, Savu, Timor, Roma-island, Amboina, Obi, Kei-islands.

— Mergui-archipelago (Further India). — Southern Red Sea. — North Australia.

Fossil in the Upper-Miocene and in the Pliocene of Java and in the Pliocene of Timor.

FAM. **VERMETIDAE.**

28. **Tenagodes (Agathirses) cumingi** Mörch.

Figure 1.

1860 *Siliquaria Cumingii*. Mörch in: Proceedings Zoological Society, London, 1860, p. 403.
1878 — — Sowerby in Reeve (97), vol. XX, Siliquaria, pl. I, figs. 2, 3 (2 b).
1886 — — Sowerby, Thesaurus (106), vol. V, p. 164, pl. 480, fig. 6.

1886 *Siliquaria (Agathirses) Cumingii.* Tryon (109), vol. VIII, p. 190, pl. 57, fig. 19; pl. 58, fig. 21.
1899 *Siliquaria Cumingii.* Melvill and Standen, Torres Straits (77), p. 170.
1909 *Tenagodus (Agathirses) Cumingi.* Schepman (104), p. 184.

Surabaya, Harbour, mud, 1 specimen (figure 1). The specimen is characterized by the granular lirae below. In this respect it agrees very well with the specimens from the Siboga-expedition assigned to *Tenagodes cumingi* by Schepman. It is somewhat more regularly wound than the latter specimens, but this characteristic is of course of no importance in the genus.

Distribution: Eastern part of the Malay Archipelago: Sumbawa, Sumba, 'Buton near Celebes, Waigeu-island, Halmahera Sea near New Guinea.
— Torres Straits. — Philippines, Japan.

FAM. **MELANIIDAE.**

For the classification of *Melaniidae* I have followed Annandale (1) and Prashad (95). *Melanoides* Olivier and *Acrostoma* Brot (= *Brotia* in von Martens (69)) are considered by Annandale as distinct genera as well as *Melania* Lamarck. The javanese group of *Melania testudinaria* and *sulcospira* is not dealt with by Annandale, they seem to me to belong to none of the genera accepted by that author, so I have adopted provisionally *Sulcospira* (Troschel, 1857) as a distinct genus. The name *Pachychilus* (Lea, 1850), originally used for Central American species, has been applied by Brot and others to members of this group, but there does not seem to be a close relationship between the javanese and the american species.

Genus **Sulcospira,** Troschel.

29. **Sulcospira testudinaria** von dem Busch sp..

1842 *Melania testudinaria.* von dem Busch in Philippi, Abbildungen (86), vol. I, p. 3, Melania, pl. I, fig. 14.

1849 *Melania testudinaria*. Mousson, Java (79), p. 66, pl. XI, figs. 1—3.
1860 — — Reeve (97), vol. XII, Melania, pl. XXI, fig. 154.
1875 *Melania (Pachychilus) testudinaria*. Brot, Melaniaccen (9), p. 49, pl. 6, fig. 3 a.
1890 *Melania (Sulcospira) testudinaria*. O. Boettger (5), p. 151.
1891 — — — O. Boettger (6), pp. 245, 278.
1897 — — — von Martens (69), pp. 31—32, 303.
1899 *Melania (Pachychilus) testudinaria*. Horst et Schepman (31), p. 248.
1905 — — — K. Martin, Foss. von Java(73), p. 236, pl. XXXVI, figs. 558—561.
1911 — — — H. Martin–Icke, Trinil (76), p. 50.
1912 *Melania testudinaria*. Schepman (103), p. 236.
1914 *Melania (Sulcospira) testudinaria*. Leschke, Java und Celebes (58), pp. 217, 251—252.
1919 *Melania testudinaria*. K. Martin (75), pp. 96, 141.
Compare also: Cossmann (12), vol. VIII, 1909, p. 126.

Penawangan, Resid. Semarang, 2 specimens.
Sawah's (rice-fields) near Pradjekan, S. of Situbondo, Resid. Besuki, 3 specimens.

Tandjong Priok near Batavia (Strubell). Buitenzorg (Strubell, von Martens), Residency Preanger: Tjiandjur (von Martens); Lake Situ-Bagendit near Garut; Malangbong (F. Jagor). Resid. Semarang: Semarang (von Martens); Tuntang River (Jacobson). Central Java: In the river of Surakarta (Solo) and near Jokjakarta (von Martens). East Java: Near Surabaya and Pasuruan (von Martens); Rogodjampi, southward of Banjuwangi (Collect. Mousson).

This species seems to be confined to Java; Strubell's locality Amboina is at least very doubtful.

Fossil occurence: Pliocene of Sondé and Pleistocene of Trinil (Resid. Madiun, East Java).

Genus **Melanoides,** Olivier, 1804.

As has been pointed out by Annandale and Prashad ((3), p. 28), the groups *Plotia* and *Striatella* as defined by Brot (9) fade imperceptibly into one another. Within the genus *Melanoides* Prashad (95) has therefore united these two groups into one subgenus, for which he adopts the older name *Plotia* = *Melanoides s. str.*. I think the latter name will be preferable.

30. **Melanoides (s. str.) crepidinata** Reeve sp..

1859 *Melania crepidinata.* Reeve (97), vol. XII, Melania, pl. XVII, fig. 120.
1877 *Melania (Striatella) crepidinata* Rve.. Brot, Melaniaceen (9), p. 238, pl. 25, figs. 13, 13a.
1897 *Melania (Melanoides) crepidinata.* von Martens (69), pp. 56, 305.
1899 *Melania (Striatella) crepidinata.* Horst et Schepman (31), p. 258.
1914 *Melania (Melanoides) crepidinata.* Leschke, Java und Celebes (58), p. 254.

Sawah's (rice-fields) at Penawangan, Resid. Semarang, 7 specimens.

The largest specimen measures 24 mm. by 9 mm., the mouth measures 8 mm. (height) by 5 mm..

In Reeve's description of the species the habitat Java is given with much doubt („supposed to be from Java"). von Martens mentions Java only on the authority of Reeve; in the Leyden Museum there are however specimens from Java, collected by Junghuhn, but without exact locality.

Distribution: Sumatra (rivulet near Singkarah, N. E. of Padang). Borneo. Palawan (Philippines, N. of Borneo).

This species has also been mentioned from Celebes, but wrongly according to P. and F. Sarasin ((101), p. 56).

31. **Melanoides (s. str.) tuberculata** O. Fr. Müller sp..

1774 *Nerita tuberculata.* O. Fr. Müller, Vermium terrestrium et fluviatilium seu animalium infusoriorum, helminthicorum, et testaceorum, non marinorum, Succincta Historia, vol. II, p. 191.

1779 *Strombus costatus etc.*. Schröter, Geschichte der Flusskonchylien, p. 373, nr. 171, pl. VIII, fig. 14.

1786 *Nerita tuberculata etc.*. Chemnitz, Neues systematisches Conchylien-Cabinet, vol. IX, p. 183, pl. 136, fig. 1262.

1788-'90 *Helix acicula*. Gmelin, Syst. Nat., edit. XIII (27), p. 3668.

1789 *Bulimus tuberculatus*. Bruguière, Encycl. méthodique (10), vol. I, part 1, p. 330.

1804 *Melanoides fasciolata*. Olivier, Voyage dans l'empire Ottoman, l'Egypte et la Perse, II, p. 40, pl. 31, fig. 7.

1822 *Melania fasciolata*. Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 167, nr. 16.

— — *truncatula*. Lamarck, ibid., p. 167, nr. 15.

1823 — *fasciolata*. Cailliaud, Voyage à Méroé, IV, p. 264, pl. LX, fig. 8.

1830 *Melania mauriciae*. Lesson, Voyage autour du monde, exécuté sur la corvette de S. M. la Coquille, pendant les années 1822–'25; Zoologie, vol. II, p. 354.

1834 — *virgulata* Fér.. Quoy et Gaimard, Voyage de découvertes de l'Astrolabe (96), vol. III, p. 141, pl. 56, figs. 1—4.

— — *Truncatula*. Quoy et Gaimard, ibid., p. 143, pl. 56, figs. 5—7.

1838 — *fasciolata*. Potiez et Michaud, Galérie des Mollusques, ou Catalogue méthodique, descriptif et raisonné des mollusques et coquilles du Muséum de Douai, p. 260, pl. 27, figs. 17, 18.

— — *punctata* (*not* of Lamarck). Potiez et Michaud, ibid., p. 262, pl. 27, figs. 15, 16.

— — *truncatula* Lk.. Potiez et Michaud, ibid., pl. 27, figs. 21, 22.

1838 — *truncatula* Lk.. Lamarck, An. s. vert. (53), vol. VIII, pp. 433—434.

— — *fasciolata* Oliv.. Lamarck, ibid., p. 434.

— — *tuberculata*. Deshayes in Lamarck, ibid., p. 434, note 1.

— — *virgulata* Fér.. Deshayes in Lamarck, ibid., p. 437.

1841 *Melania truncatula* Lk.. B. Delessert, Recueil des Coquilles décrites par Lamarck dans son Histoire des Anim. sans Vertèbres, et non encore figurées, pl. 30, figs. 17a, 17a.

1842 *Melania tuberculata* Müll.. Philippi, Abbild. (86), vol. I, pp. 4—6; Melania, pl. I, fig. 19.

1847 *Melania suturalis*. Philippi, Abbild. (86), vol. II, p. 173; Melania, pl. IV, fig. 17.

— — *pyramis*. von dem Busch in Philippi, ibid., p. 172, Melania, pl. IV, fig. 16.

1849 *Melania tuberculata* Müll.. Mousson, Java (79), p. 73, pl. XI, figs. 6, 7.

1854 *Melanoides tuberculata* Müll.. H. and A. Adams, The Genera of recent Mollusca arranged according to their organization, vol. I, p. 297.

1858 *Melania Layardi*. Dohrn in: Proceedings of the Zoological Society, p. 135.

1859 *Melania tuberculata* Müller. Reeve (97), vol. XII, Melania, species 87, pl. XIII, fig. 87; pl. XVI, fig. 110.

— — *Layardi* Dohrn. Reeve, ibid., spec. 104, pl. XV, fig. 104.

— — *virgulata* Férussac. Reeve, ibid., spec. 109, pl. XVI, fig. 109a.

— — *punctulata* Grateloup. Reeve, ibid., pl. XV, fig. 100.

— — *gemmulata*. Reeve, ibid., spec. 86, pl. XIII, fig. 86.

1860 *Melania beryllina*. Brot in: Revue et Magasin de Zoologie, p. 262, pl. 17, fig. 18.

1861 *Melania Rothiana*. Mousson, Coquilles rec. par Roth en Palestine, p. 61.

1864 *Melania tuberculata* Müll.. Bourguignat, Malacologie de l'Algérie, vol. II, p. 251, pl. 15, figs. 1—11.

1865 *Melania rubropunctata*. Tristram in: Proceedings Zoological Society, p. 541.

1871 *Melania tuberculata* Müll.. Brot, Catal. Melanidae in: American Journal of Conchology, VI, p. 294.

1872 *Melania fasciolata* Olivier. Brot, Matériaux pour servir à l'étude de la famille des Mélaniens, III, p. 22, pl. 1, fig. 7.

1872 *Melania truncatula* Lk.. Brot, ibid., p. 22, pl. 1, fig. 13.
1876 — *Layardi* Dohrn. Hanley and Theobald, Conchologia Indica, p. 31, pl. 73, figs. 8, 9.
— — *tuberculata*. Hanley and Theobald, ibid., p. 32, pl. 74, figs. 1—4.
1877 *Melania (Striatella) tuberculata* Müller. Brot, Melaniaceen (9), p. 247, pl. 26, figs. 11, 11 a—h.
1882 *Melania tuberculata* Müller. E. A. Smith, Freshw. shells of Australia (104 ter), p. 259.
1884 — — Müll.. K. Martin, Tiefbohr. Java (72), pp. 157—158.
1886 *Melania (Striatella) tuberculata* Müll.. Westerlund, Fauna der in der paläarctischen Region lebenden Binnenconchylien, VI, pp. 103—104.
1891 *Melania tuberculata* Müll.. L. Morlet in: Journal de Conchyliologie, vol. XXXIX, p. 234.
1891 — — — P. Fischer, Indo-Chine (22), p. 169 (85).
1891 *Melania virgulata* Fér. var.. P. Fischer, ibid., p. 169 (85).
1897 *Melania (Melanoides) tuberculata* Müll.. von Martens (69), pp. 56—59, 305.
1898 *Melania tuberculata* Müll. var. *virgulata* Fér.. P. u. F. Sarasin, Süsswassermollusken Celebes (101), p. 45, pl. IV, figs. 43, 44.
1899 *Melania (Striatella) tuberculata* Müller and var. *mauriciae* Lesson. Horst et Schepman (31), pp. 258, 259.
1901 *Melania tuberculata* Müller sp.. H. Fischer, Djibouti, etc. (22*a*), p. 113.
1905 *Melania (Striatella) tuberculata*. K. Martin, Foss. v. Java (73), p. 238.
1905 *Melania tuberculata* Müller. Dautzenberg et H. Fischer (17), pp. 141—146.
1906 — — — Dautzenberg et H. Fischer (18), p. 413.
1909 *Melania (Melanoïdes) tuberculata* Müller and var. *fasciolata* Olivier. Pallary, Catal. faune malac. d'Égypte (79*a*), p. 67, pl. IV, figs. 23—25.

1911 *Melania (Striatella) tuberculata.* H. Martin–Icke, Trinil (76), p. 50.
1914 — *(Melanoides)* — Leschke, Java u. Celebes (58), pp. 218, 254—255.
1918 *Melania tuberculata.* Annandale in: Records of the Indian Museum, vol. XIV, pp. 114, 156, fig. 6, pl. XII, figs. 1, 2.
1919 *Melanoides tuberculata* (Müller). Annandale and Prashad, Moll. of Baluchistan (3), pp. 31—32, pl. IV, fig. 1.
1919 *Melania tuberculata.* K. Martin (75), pp. 96, 134, 141, 143.
1921 *Melanoides tuberculata.* Prashad, Lower Mesopotamia (94), p. 224.
1921 *Melanoides (Plotia) tuberculata.* Prashad, Sumatra (95), pp. 491—492.

Coast near mouth of river Tji Lamaja, 28 specimens. It is evident, that the shells have been carried here by the river. The specimens are of a light yellowish colour, painted with chestnut flames; they have all a conspicuous basal band.

There are but a few shells, that are transversely ribbed and these have the ribs only on the first whorls. In consequence the shells may be assigned to the form *virgulata* (Férussac) Quoy et Gaimard (Mousson, Java, pl. XI, fig. 6; Brot, Melaniaceen, figs. 11 c—d), with transitions however to the form *plicifera* Mousson (Mousson, Java, pl. XI, fig. 7; Brot, l. c., figs. 11, 11 a). From the descriptions by von Martens it results, that the above-cited „varieties" are not at all sharply definite, as has been also pointed out before by K. Martin (72).

Melania tuberculata is a common species in Java, especially in rice-fields and brooks, besides it has been recorded from nearly all islands in the East Indian Archipelago: Sumatra, Borneo, Celebes, Togean-islands, Saleyer, Flores, Adonara, Rotti, Timor, Amboina, Ceram, Bachan.

Distribution: This species has an extremely wide range, from the Mediterranean, Somaliland and Madagascar to China and Queensland. Although it occurs in India and in Lower Mesopotamia, it has not yet been found in Baluchistan or Southern Persia.

Fossil: Upper Miocene, Pliocene and Pleistocene of Java.

32. **Melanoides (Tarebia) asperula** Brot sp..

? [1849 *Melania semigranosa* (*non* von dem Busch). Mousson, Java (79), p. 74, pl. X, fig. 7].
1877 *Melania (Tarebia) asperula*. Brot, Melaniaceen (9), p. 327, pl. 33, figs. 11, 11a.
1890 — — — O. Boettger (5), p. 153.
1897 — — — von Martens (69), p. 305.
1914 — — — Leschke, Java und Celebes (58), p. 257.

River Kali Sampean, Situbondo, Resid. Besuki, 2 specimens.

Both specimens have the 3 longitudinal brown bands (most distinctly visible within the mouth) of *Mel. asperula*, not the dark lines of *M. lineata*. The longitudinal grooves are crispated.

One specimen has 3 conspicuous rows of granules and is a very typical specimen of *Mel. asperula*; in the other specimen only the upper row of granules is distinct, the other rows being very faintly developed.

Specimens from Pasuruan (collected by H. Fruhstorfer) in the Senckenberg Museum in Frankfort show also 3 conspicuous rows of granules, whereas specimens from the Banjuwangi-division, Resid. Besuki (Museum Amsterdam) have only one conspicuous row of granules. *Melania asperula* seems to be confined to Java. In West-Java it was collected in the rivulet Tji Liwung near Buitenzorg by Strubell.

FAM. **LITTORINIDAE.**

33. **Littorina (Littorinopsis) melanostoma** Gray.

Figure 2.

1839 *Littorina melanostoma*. Gray, Zoology of Beechey's voyage, p. 140.
1847 *Litorina melanostoma*. Philippi, Abbildungen (86), vol. II. p. 224, Litorina, pl. V, fig. 16.
1857 *Littorina melanostoma*. Reeve (97), vol. X, Littorina, pl. IX, figs. 45 a, b.
1882 *Litorina melanostoma*. Weinkauff, Litorina (50), p. 41, pl. 4, fig. 19.

1887 *Littorina (Melaraphe) melanostoma.* Tryon (109), vol. IX, p. 245, pl. 43, figs. 42, 43.
1887 — *melanostoma.* von Martens, Mergui (67), p. 170.
1897 — *(Littorinopsis) melanostoma.* von Martens (69), p. 199.
1899 — *melanostoma.* Horst et Schepman (31), p. 283.
1905 — *(Melaraphe) melanostoma.* Dautzenberg et H. Fischer (17), pp. 148, 149.
1909 — *melanostoma.* Lamy, Java (56), p. 467.
1919 — — Annandale and Prashad (2), p. 245.

Coast near mouth of river Tji Lamaja, 1 somewhat worn specimen.

Coral-island Pulu Pandjang, 1 specimen (figure 2).

Von Martens did not know this species from the Dutch East Indies; Lamy mentions it from Java, but without distinct locality.

Distribution: Sarawak (Borneo), Amoy in China, Tongking (on mud), Singapore, Mergui Archipelago („in grass and on mangrove-trees at spring-tide level"), Burma (in estuaries), Gangetic Delta („in large numbers on grass and bushes exposed at low tide, but submerged when the tide rises"), Ceylon (mangrove-swamps).

34. **Tectarius** (**Nodilittorina**) **vilis** (Menke) Philippi sp..

Figures 3 a, b, c.

1846 *Litorina vilis* (Menke in litt.). R. A. Philippi, Abbildungen (86), vol. II, p. 145, Litorina, pl. 2, fig. 21.
1857 *Littorina vilis.* Reeve (97), vol. X, Littorina, spec. 12, pl. II, fig. 12.
1882 *Litorina vilis.* Weinkauff, Litorina (50), p. 93, pl. 13, figs. 9, 12.
1887 *Tectarius nodulosus* Gmelin, pars. Tryon (109), vol. IX, p. 258, pl. 47, fig. 64.
1897 *Littorina (Nodilittorina) vilis* Menke. von Martens (69), pp. 204, 205.
1899 *Tectarius vilis* Philippi. Horst et Schepman (31), p. 285.

Mantjingan, south coast, 4 specimens (some of them with the soft parts), (figures 3 a—c).

Distribution: In the Dutch East Indies this species was hitherto known from Java and Banka only. In Banka it was found by von Martens on rocks above the sea-level. — Singapore, Mergui Archipelago, Ceylon, Natal. — Gulf of Siam, Hongkong, Swatow and Amoy (China), Formosa, Luzon (Philippines).
— ? New Britain near New Guinea, ? Marquesas Is.. — ? New Zealand.

FAM. **SOLARIIDAE.**

35. **Solarium perspectivum** Linné sp..

1758 *Trochus perspectivus*. Linné. Systema Naturae, edit. X, p. 757.
1844 *Solarium formosum*. Hinds in: Proceedings Zoological Society, London, 1844, p. 22.
1849 *Solarium incisum*. Philippi, Centuria tertia test. nov. (88), p. 169, species 45.
— — *zonatum*. Philippi, ibid., p. 173, spec. 54.
1853 *Solarium incisum*. Philippi. Solarium (93), p. 27, pl. 4, fig. 6.
1864 *Solarium perspectivum* Linn.. Reeve (97), vol. XV, Solarium, spec. 11, pl. II, figs. 11 a, b.
1866 *Solarium (Architectonica) perspectivum* Linn.. Hanley in Sowerby, Thesaurus (106), vol. III, p. 228, pl. 253, figs. 36, 37, 38.
1886 — — — Boog Watson, Challenger Gasterop. (8), p. 135.
1887 *Solarium perspectivum* Linn.. Marshall in Tryon (109). vol. IX, p. 8, pl. 2, figs. 18, 19.
1887 — — — von Martens, Mergui (67), p. 193.
1899 — — — Horst et Schepman (31), p. 287.
1903 — — — Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 212, 215, 233, 259, 278—279.

1905 *Solarium (s. str.) perspectivum* Linn.. K. Martin, Foss. v. Java (73), pp. 246, 247, pl. XXXVII, figs. 594—597.
1909 *Solarium perspectivum* Linn.. Schepman (104), p. 218.
1911 *Solarium (s. str.) perspectivum*. H. Martin–Icke, Trinil (76), p. 47.
1911-'12 *Solarium perspectivum*. K. Martin, Vorläuf. Bericht (74), pp. 21, 47, 159.
1919 — — K. Martin (75), pp. 97, 127, 128, 132, 133, 142.
1920 — — Tesch, Timor (108), II, p. 65, pl. CXXXII, fig. 200.

Surabaya, Harbour, mud, 1 specimen.

Coast of Residency Besuki, East-Java (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Billiton, Lombok, Sumbawa, Timor, Buton-strait (S. E. of Celebes), Amboina, Bachan, East coast of Halmahera (Museum Wageningen), Waigeu, Misol.

— Philippines, Singapore, Salang-island, Mergui Archipelago, Gulf of Aden, Red Sea and Gulf of Akabah, Zanzibar, Madagascar.

Fossil in the Lower and Upper Miocene and in the Pliocene of Java. Pliocene and Pleistocene of Timor.

36. **Solarium modestum** Philippi.

Figure 4.

1849 *Solarium modestum*. Philippi, Centuria tertia test. nov. (88), p. 171.
1853 — — Philippi, Solarium (93), p. 15, pl. 3, fig. 1.
1864 — — Reeve (97), vol. XV, Solarium, species 12, pl. II, fig. 12.
1866 *Solarium (Architectonica) modestum*. Hanley in Sowerby, Thesaurus (106), vol. III, p. 229, pl. 250, figs. 11, 12; pl. 252, figs. 27, 28.
1887 *Solarium modestum*. Marshall in Tryon (109), vol. IX, p. 9, pl. 2, figs. 22, 23.
1899 — — Horst et Schepman (31), p. 287.

1909 *Solarium modestum*. Schepman (104), p. 219.

Shore of Bali-strait, north of Banjuwangi, 1 specimen (figure 4).

The only specimen, though not adult, is quite typical and agrees very well with Hanley's figures 11 and 12.

Djangkar, North coast of Resid. Besuki (Siboga exped.).

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Lombok, Sumbawa, Flores, Savu, Timor, Amboina.

— China. — Society Isles.

Marshall's remark, that *Solarium modestum* differs from *S. perspectivum* in the colouring only, is not right, as *S. modestum* is bisulcate below the suture („Anfractus superne bis longitudinaliter sulcati", Hanley). In sculpture it agrees therefore more with *Sol. pictum* and *Sol. maximum* (as remarks Prof. K. Martin). I cannot agree with Dr. Tesch ((108), II, p. 66) in considering it more allied in sculpture to *S. perspectivum*.

37. **Solarium perdix** Hinds.

1844 *Solarium perdix*. Hinds in: Proceedings Zoological Society of London, 1844, p. 22.

1864 — — Reeve (97), vol. XV, Solarium, species 1, pl. I, fig. 1.

1866 *Solarium (Architectonica) perdix* Hinds. Hanley in Sowerby, Thesaurus (106), vol. III, p. 233, pl. 251, figs. 17, 18.

1887 *Solarium perdix* Hinds. Marshall in Tryon (109), vol. IX, p. 9, pl. 2, figs. 24, 25.

Coast near mouth of river Tji Lamaja, 6 specimens.

Coast near Government Rubber Estate Balong, N. E. of Japara (Resid. Semarang), 1 specimen.

Distribution: Malacca, Ceylon, North-West Australia.

Some of my specimens from Java are somewhat bleached, but the colour-pattern is still conspicuous. They agree very well with Hanley's figures (in the Thesaurus), except one specimen being more elevated conical, hence the depressed conical form of the shell, mentioned in Hanley's diagnosis, proves to be no constant character.

Solarium dunkeri Hanley from the „Indian Archipelago"

differs from our species chiefly in colour, as the difference in shape does not stand.

From *Sol. perspectivum* our species is easily distinguished, not only by the different colour-pattern, but also by the smaller pearl-like crenulations of the rib around the umbilicus.

FAM. **HYDROBIIDAE.**

38. **Bithynia truncata** Souleyet sp..

1852 *Paludina truncata*. Souleyet, Voyage de la Bonite (20), vol. II, p. 548, pl. 31, figs. 22—24.
1865 *Bythinia truncata*. von Frauenfeld, Verzeichniss Paludina (24), p. 656.
1897 *Bithynia truncata* Eyd. Soul.. von Martens (69), pp. 25, 26, 302, pl. IX, figs. 11, 11 b.
1899 *Bithinia* — Eydoux et Souleyet. Horst et Schepman (31), p. 310.
1909 *Bithynia* — — — — Schepman (104), p. 196.
1911 — — Eyd. und Sow.. H. Martin–Icke, Trinil (76), p. 50.
1914 — — Leschke, Java und Celebes (58), p. 261.
1919 — — Eyd. et Sow.. K. Martin (75), pp. 97, 143.
1921 — — Eyd. and Soul.. Prashad, Sumatra (95), p. 484.

Penawangan, Resid. Semarang, 1 specimen.

Swamp near Batavia (Leyden Museum). Malang (Resid. Pasuruan) (von Martens). Lake of Grati near Pasuruan (von Martens). Rivulet near Djangkar, N. coast of Resid. Besuki (Siboga expedition).

Distribution: Deli, Sumatra (fresh-water areas); Southern Celebes.

— Bangkok (Siam), Burma, Ganges (Souleyet!).

Fossil in the quaternary river-deposits at Trinil, Resid. Madiun, Java.

FAM. **VIVIPARIDAE.**

39. **Viviparus javanicus** von dem Busch sp..

1844 *Paludina javanica*. von dem Busch in Philippi, Abbildungen (86), vol. I, p. 114, Paludina, pl. I, figs. 11, 12.

1849 *Paludina javanica*. v. d. Busch. Mousson, Java (79), p. 61, pl. VIII, figs. 3, 4.
1852 — — Küster (47a), p. 24, pl. 5, figs. 7—10.
1863 — *Javanica*. Reeve (97), vol. XIV, Paludina, fig. 52.
1865 *Vivipara javanica*. von Frauenfeld, Verzeichniss Paludina (24), p. 615.
1890 *Paludina javanica*. O. Boettger (5), p. 155.
1891 — — O. Boettger (6), p. 249.
1897 *Vivipara Javanica* Busch. von Martens (69), pp. 21—22, 302.
1898 — *javanica*. P. und F. Sarasin, Süsswassermoll. Celebes (101), p. 64.
1899 *Paludina javanica*. Horst et Schepman (31), p. 314.
1905 *Paludina (s. str.) javanica* v. d. Busch var.. K. Martin, Foss. v. Java (73), pp. 249—250, pl. XXXVII, figs. 601—603.
1908 *Vivipara javanica*. Kobelt (47a), p. 251, pl. 52, figs. 1—7.
1909 — — Schepman, Siboga exped. (104), p. 197.
1911 *Paludina* — H. Martin–Icke, Trinil (76), p. 50.
1914 *Vivipara* — Leschke, Java u. Celebes (58), pp. 220, 260—261.
1919 *Paludina* — v. d. Busch var.. K. Martin (75), pp. 98, 139, 143.
1921 *Vivipara* — (v. d. Busch). Prashad, Sumatra (95), p. 480.

The typical form is represented in the collection from the following localities:

Sawah's (rice-fields) at Penawangan, Resid. Semarang, 1 specimen.

Coast near mouth of river Tji Lamaja, 18 specimens; most of the shells are worn.

Shore of Bali-strait, north of Banjuwangi, 1 worn specimen.

The shells collected on the sea-shore must have been carried there by rivers.

The typical form of *Viviparus javanicus* is widely distributed in Java, inhabiting rivers, pools and rice-fields from Bantam in the western part to Pasuruan in the East. It occurs as well in the mountainous districts of the Preanger as in the coastal plain. Besides from Java it has been recorded from Madura, Bali, Palembang (Southern Sumatra), Borneo and from a brook at Amboina.

From Java *Viviparus javanicus* is recorded as a fossil in the Pleistocene.

Forma **moussoni** von Martens.

1849 *Paludina angularis* (*not* of Müller). Mousson, Java (79), p. 62, pl. VIII, fig. 5.
1897 *Vivipara Javanica* var. *Moussoni*. von Martens (69), pp. 22—23.
1899 *Paludina javanica*, var. *Moussoni* v. Martens. Horst et Schepman (31), p. 314.
1908 *Vivipara javanica moussoni*. Kobelt (47a), p. 256, pl. 52, figs. 10—11.
1914 *Vivipara javanica* v. *moussoni*. Leschke, Java und Celebes (58), p. 261.
1921 *Vivipara javanica* var. *moussoni*. Prashad, Sumatra (95), pp. 481—482.

Coast near mouth of river Tji Lamaja, 2 specimens. Hitherto recorded from West-Java (Resid. Bantam; near Batavia and Buitenzorg; Resid. Preanger) and from Sumatra (Medan).

This has a more distinct spiral sculpture than the typical *javanicus*. I think it will prove to be merely a form of that species and not a distinct subspecies as Kobelt considered it to be.

One of the fossil shells from Kali Tjemoro, Surakarta (?Pleistocene), figured by K. Martin ((73), fig. 604), probably belongs to the form under consideration, though it has the spiral sculpture still more marked.

FAM. **AMPULLARIIDAE.**

40. **Pachylabra conica** Gray sp..

1828 *Ampullaria conica*. Gray in Wood, Supplement to the Index Testaceologicus, pl. VII, fig. 22.
1849 — *orientalis*. Philippi (88), p. 192.
1849 — *scutata*. Mousson (79), p. 60, pl. VIII, fig. 2.
1851 — — Philippi (89), p. 9, pl. I, figs. 4, 5.
1854 — *conica*. Hanley, Conchol. Miscellan., pl. III, fig. 13.
1856 — — Wood. Reeve (97), vol. X, Ampullaria, pl. II, fig. 10.

1856 *Ampullaria Javanica*. Reeve (97), vol. X, Ampullaria, pl. XX, fig. 96.
1857 *Ampullaria scutata*. von Martens in: Malakozoologische Blätter, p. 186.
1877 *Ampullaria conica* near *type form*, var. *orientalis* and ? *borneensis*. Nevill, Catal. of Mollusca in the Indian Museum; Fasc. E, pp. 7—10.
1885 *Ampullaria conica typical form*, vars. *orientalis* and ? *borneensis*. Nevill, Hand-List Moll. Ind. Museum, vol. II, p. 5.
1890 *Ampullaria conica* Gray var. *javanica* Rve.. O. Boettger (5), p. 156.
1897 *Ampullaria scutata*. von Martens (69), pp. 18—19.
1898 — — P. und F. Sarasin (101), p. 69.
1899 *Ampullaria (Pachylabra) scutata*. Horst et Schepman (31) p. 319.
1910 *Ampullaria conica*, and vars. *borneensis, Javanica, orientalis* and *scutata*. G. B. Sowerby (107), pp. 57, 58.
1911 *Ampullaria (Pachylabra) scutata*. H. Martin-Icke (76), p. 50.
1912 *Pachylabra conica*. Kobelt (34), p. 93, pl. 40, figs. 1—5, 8, 9.
— — *javanica*. Kobelt (34), p. 83, pl. 35, fig. 6.
1912 *Ampullaria scutata*. Schepman (103), p. 236.
1914 *Ampullaria (Pachylabra) scutata*. Leschke (58), pp. 221, 262, 283.
1915 *Pila conica* and var. *orientalis*. Preston, Faun. Brit. Ind., Freshwater-Moll., pp. 100, 101.
1920 *Pachylabra conica*. Annandale in: Journal of the Natural History Society of Siam, vol. IV, pp. 9, 10, pl. I, fig. 3; pl. II, fig. 2.
1921 — — Prashad, Sumatra (95), p. 477.
1922 *Ampullaria scutata*. Paravicini (80), p. 27, fig. 5.

Buitenzorg, Botanical Gardens, 1 specimen.
Penawangan (Residency Semarang), in sawah's (rice-fields), 6 specimens.
Coast near mouth of river Tji Lamaja, 19 specimens, most are somewhat worn.

Surabaya, shore of Bandjaran, 1 bleached specimen.

Pardana (Pĕrdana), Residency Bantam (Zollinger). Djocja (Jacobson). Malang, Resid. Pasuruan (Leyden Museum). Tjilatjap, south coast (Leyden Museum).

Distribution: Sumatra, Banka, Borneo, Celebes, Bali. — Singapore, Malacca, Pulu Penang, Tenasserim, Cambodia to southern China.

According to Paravicini this species is very common in the rice-fields of Java and is eaten by the Javanese.

My specimens from the shore near Tjilamaja and Surabaya are empty shells, that must have been brought there by rivers.

Fossil in the quaternary river deposits at Trinil.

41. **Pachylabra polita** Deshayes sp..

1830 *Ampullaria polita*. Deshayes, Encyclopédie méthodique; Vers, vol. II, p. 31, nr. 8.
1838 — — Deshayes in Lamarck, An. s. vert. (53), vol. VIII, p. 544.
1852 — — Philippi (89), p. 29, pl. 8, fig. 1.
1856 — — Reeve (97), vol. X, Ampullaria, pl. VII, fig. 35.
1891 — — P. Fischer, Indo-Chine (22), p. 181 (97).
1897 — — von Martens (69), p. 302.
1899 *Ampullaria (Pachylabra) polita*. Horst et Schepman (31), p. 319.
1905 *Ampullaria polita*. Dautzenberg et H. Fischer (17), p. 161.
1906 — — Dautzenberg et H. Fischer (18), p. 426.
1912 *Pachylabra polita*. Kobelt (34), p. 82, pl. 38, figs. 1—5.
1914 *Ampullaria polita*. Leschke, Java und Celebes (58), p. 262.

Surabaya, shore of Bandjaran, 1 empty shell.

Tjilatjap (Leyden Museum).

Distribution: ? Borneo. — Cambodia; Cochin China, river Mekong; Tongking (rice-fields, pool near Luc-Nam, Hanoi).

According to Kobelt *P. polita* is a characteristic species for the eastern part of Further India. He questions its occurence at Java, the species not being recorded from that island since it was mentioned by Philippi (after Winter's collections from Java). He has however overlooked the locality Tjilatjap

in the catalogue of the Leyden-Museum. My specimen from the shore near Surabaya is a very typical one and agrees in all respects with specimens in the Senckenberg Museum.

The locality Port Jackson in New South Wales (Reeve) is without doubt incorrect.

FAM. **TRUNCATELLIDAE.**

42. **Truncatella valida** Pfeiffer.

Figures 5 a, b, c.

1846 *Truncatella valida*. Pfeiffer (82), p. 182.
1855 — — Küster (41), p. 11, pl. 2, figs. 19—21, 23.
1856 — — Pfeiffer, Monogr. Auricul. (83), p. 184.
1867 — — von Martens (62), p. 162.
1891 — — O. Boettger (6), p. 298.
1900 — — Pfeiffer. E. A. Smith, Christmas Island (104d), p. 59, pl. VIII, figs. 21, 22.

Mantjingan, south coast, 6 specimens (figures 5 a—c).
Long. of the largest specimen: 10 mm.

Distribution: East Indian Archipelago: Timor, near Kupang on a piece of rock on the shore, washed but not submerged by the waves; Amboina, on the shore; Tawalli-island north of Bachan (Moluccas).
— Singapore, Malay Peninsula, Philippines. — New Caledonia, Samoa. — Christmas Island south of Java.

FAM. **CYCLOPHORIDAE.**

43. **Cyclophorus** (**Glossostylus**) **rafflesi** Broderip et Sowerby sp..

1834 *Cyclostoma Rafflesii*. Broderip and Sowerby in: Zoological Journal, V, p. 50.
1847 *Cyclostoma oculus-capri* Wood. Sowerby, Thesaurus (106), vol. I, p. 115, pl. XXV, fig. 96.
1847 *Cyclostoma oculus capri*. Pfeiffer (85), p. 26, pl. 3, figs. 5, 6.

1849 *Cyclostoma oculus capri.* Mousson (79), p. 52, pl. VI, figs. 1, 2.
1861 *Cyclophorus oculus-capri.* Reeve (97), vol. XIII, Cyclophorus, figs. 8 a, b.
1867 *Cyclophorus Rafflesii* Brod.. von Martens (62), p. 132.
1890 — *rafflesi* and var. *decarinata* Mouss.. O. Boettger (5), p. 161.
1899 *Cyclophorus (Glossostylus) Rafflesi.* Horst et Schepman (31), p. 330.
1914 — — *rafflesi.* Leschke, Java und Celebes (58), p. 243.

Forest near Mountain Gardens of Tjibodas, 2 specimens.
Forest on the northwestern slope of the Malabar, south of Bandung, 1 specimen.
Buitenzorg, Botanical Gardens (Strubell). Gunung Salak, south of Buitenzorg (Van Hasselt; Strubell). Sindanglaja near Tjibodas, between Buitenzorg and Tjiandjur, Resid. Preanger (von Martens). Palabuan near coast of Wijnkoopsbay (von Martens). Between Bandjar and Kaliputjang in the south-east of the Resid. Preanger (Jagor).
Distribution: The occurence in Sumatra is doubtful.

44. **Cyclophorus (Salpingophorus) perdix** Broderip et Sowerby sp..

1834 *Cyclostoma perdix.* Broderip and Sowerby in: Zoological Journal, V, p. 50.
1847 — — Sowerby, Thesaurus (106), vol. I, p. 122, pl. XXVII, fig. 127.
1849 — — Mousson (79), p. 54, pl. VIII, fig. 1.
1867 *Cyclophorus perdix.* von Martens (62), pp. 136—138.
1890 — — O. Boettger (5), p. 160.
1891 — — von Martens (68), p. 216.
1899 *Cyclophorus (Salpingophorus) perdix.* Horst et Schepman (31), p. 331.
1914 — — — Leschke, Java und Celebes (58), pp. 243—244.

Teakwood at Penawangan, Resid. Semarang, 1 specimen.
Goendih, south of Poerwodadi, Resid. Semarang, 1 specimen.

Near Buitenzorg, Sindanglaja and Tjibodas (von Martens). Gunung Salak and Gunung Gedeh south of Buitenzorg (Strubell). Palabuan near Wijnkoopsbay (von Martens). Tjilatjap, South Coast (Leyden Museum). Pulu Rakata (Krakatau-island) in Sunda-strait (Collect. Mousson, fide von Martens, 1867).

Distribution: Besides in Java, this species occurs in Sumatra.

45. **Cyclophorus (Salpingophorus) zollingeri** Mousson sp..

1849 *Cyclostoma Zollingeri*. Mousson (79), p. 55, pl. VII, fig. 2.
1867 *Cyclophorus perdix* Brod. et Sow. sp., var. *Zollingeri*. von Martens (62), p. 137.
1891 *Cyclophorus perdix* (Brod. et Sow.) var. *zollingeri*. O. Boettger (6), p. 250.
1899 *Cyclophorus (Salpingophorus) perdix*, var. *Zollingeri*. Horst et Schepman (31), p. 331.
1908 *Cyclophorus (Salpingophorus) zollingeri*. Kobelt, Cyclophoridae (85), p. 694, pl. 103, figs. 9—13.
1914 — — — Leschke, Java und Celebes (58), p. 244.
1922 *Cyclophorus Zollingeri*. Van Heurn en Paravicini, Conch. der Gajo-landen (29), p. 28, fig. 3.

Forest on the northwestern slope of the Malabar, south of Bandung (Resid. Preanger), 1 specimen.

Alt. $20^1/_2$, diam. max. 31, diam. min. $22^1/_2$, alt. apert. (incluso perist.) 14, lat. apert. 16 mm.

Common in West-Java: Depok and Buitenzorg (Resid. Batavia) and Tjibodas between Buitenzorg and Tjiandjur (Resid. Preanger) (Van Heurn and Paravicini). Tengger Mountains, East-Java (Fruhstorfer). Pulu Rakata (Krakatau-island) in Sunda-strait (Collect. Mousson, fide von Martens, 1867).

Distribution: This species is widely distributed in Sumatra from the South coast (Lampong Districts) to the Gajo-lands in the northern part, besides it has been recorded from Banka.

Kobelt and Van Heurn and Paravicini consider this as a distinct species rather than as a variety of *C. perdix* as there are not found intermediate forms between them. The specific characters, though differing but very little, seem to be quite constant.

46. **Leptopoma (s. str.) vitreum** Lesson sp..

1830 *Cyclostoma vitrea*. Lesson, Voyage autour du monde, exécuté sur la corvette de S. M. la Coquille, pendant les années 1822—'25; Zoologie, vol. II, p. 346, pl. 13, fig. 6.
1832 *Cyclostoma lutea*. Quoy et Gaimard, Voyage de découvertes de l'Astrolabe (96), vol. II, p. 180, pl. 12, figs. 11—14.
1838 — *vitrea* Less.. Deshayes in Lamarck, An. s. vert. (53), vol. VIII, p. 367.
1842 — *nitidum* Sow.. Reeve, Conchologia Systematica, pl. 183, fig. 2 (bad).
1843 — — Sowerby in: Proceedings Zoolog. Society, 1843, p. 60.
1847 — — Sowerby, Thesaurus (106), vol. I, p. 133, pl. XXIX, figs. 225—227.
1847 *Leptopoma vitrea* Less.. Pfeiffer in: Zeitschrift für Malakozoologie, p. 108.
— — *nitidum* Sow.. Pfeiffer, ibid., p. 108.
1848 *Cyclostoma nitidum* Sow.. Pfeiffer, Cyclost. (85), p. 96, pl. 16, fig. 10.
1849 — *vitreum*. Pfeiffer, ibid., p. 158, pl. 28, figs. 16—18.
1849 *Cyclostoma vitreum*. Mousson (79), p. 57, pl. VI, fig. 4.
1852 *Leptopoma vitreum*. Pfeiffer, Monographia Pneumonopomorum viventium, p. 101.
1852 *Cyclophorus vitreus*. Mörch, Catalogus Yoldi, p. 42.
1858 *Dermatocera vitrea* Less.. H. and A. Adams, Genera of recent Mollusca, vol. II, p. 282, pl. LXXXV, figs. 7—7 c.
1858 — — — Pfeiffer, Monogr. Pneum., Suppl. I, p. 78.
1862 *Leptopoma vitreum*. Reeve (97), vol. XIII, Leptopoma, species 15, pl. III, figs. 15 a, b; pl. VI, fig. 32.
1865 *Dermatocera vitrea* Less.. Pfeiffer, Monogr. Pneum., Suppl. II, p. 85.

1867 *Leptopoma vitreum* Less. sp.. von Martens (62), pp. 66, 143—147, pl. 4, figs. 2 a, b, c.
1872 *Leptopoma fragile* Sow.. Mörch in: Journal de Conchyliologie, p. 317.
1876 *Leptopoma vitreum* Less.. Pfeiffer, Monogr. Pneum., Suppl. III, p. 127.
1889 — — — L. Morlet in: Journal de Conchyliologie, vol. XXXVII, p. 152.
1891 — — — P. Fischer, Catal. Indo-Chine (22), p. 190 (reprint, p. 106).
1891 — — (Less.). von Martens (68), p. 217.
1899 *Leptopoma (s. str.) vitreum* Lesson. Horst et Schepman (31), p. 323.
1902 — — — Kobelt, Cyclophoridae (85), p. 406.
1906 *Leptopoma vitreum* Lesson, var. *nitida* Sowerby. Dautzenberg et H. Fischer (18), pp. 437—439.
1914 *Leptopoma vitreum*. Leschke, Java u. Celebes (58), p. 241.

Teakwood at Penawangan, Res. Semarang, 2 specimens. The specimens belong to the normal form of von Martens and are uniformly white.

Measurements of shells (in millimetres):

	A	B
Maximum diameter	15	15
Minimum diameter	$11^1/_2$	$11^1/_2$
Height	15	15
Diameter of aperture (inclusive of peristome)	9	(damaged)

East-Java: Wonosari and Banjuwangi (Zollinger).

Distribution: Flores, Celebes, Amboina, Bachan, Ternate, Halmahera, Misol, New Guinea. — New Ireland. – Sulu-archipelago, Philippines, South Formosa. - -? Siam, Cochin China.

FAM. **CAPULIDAE.**

47. **Crucibulum** (**Bicatillus**) **renovatum** Crosse et Fischer.

1825 *Calyptraea extinctorium* (*not* of Lamarck). Blainville, Manuel de Malacol., p. 506, pl. 48, fig. 8.

1859 *Crucibulum extinctorium* (*not* of Lamarck). Reeve (97), vol. XI, Crucibulum, pl. V, figs. 14a, b.
— — *morbidum*. Reeve, ibid., pl. VII, figs. 24 a, b.
1859 *Calyptraea laevigata* (*not* of Lamarck). Chenu, Manuel (11), vol. I, fig. 2327.
1883 *Crucibulum extinctorium* (*not* of Lamarck). Sowerby, Thesaurus (106), vol. V, p. 61, pl. 449, figs. 55, 56, 58.
1886 *Crucibulum (Bicatillus) extinctorium* (*not* of Lam.). Tryon (109), vol. VIII, p. 119, pl. 33, figs.46–49.
1887 *Trochita extinctorium* (*not* of Lam.). von Martens, Mergui (67), p. 193.
1889 *Crucibulum extinctorium* (*not* of Lam.). L. Morlet in: Journal de Conchyliologie, vol. XXXVII, p. 155.
1889 *Crucibulum renovatum*. H. Crosse et P. Fischer (14), p. 288.
1891 — — P. Fischer, Indo-Chine (22), p. 193 (reprint, p. 109).
1900 *Bicatillus extinctorium* (*not* of Lamarck). Dautzenberg, Sumatra (15), p. 4.
1905 *Crucibulum (Bicatillus) extinctorium* (*not* of Lamarck). K. Martin, Foss. von Java (73), pp. 250—251, pl. XLI, figs. 674, 675.
1906 *Crucibulum (Bicatillus) renovatum* Cr. et F.. Dautzenberg et H. Fischer (18), p. 445.
1908 *Crucibulum (Bicatillus) extinctorium* (*not* of Lamarck). Horst et Schepman (31), p. 366.
1919 *Crucibulum extinctorium* (*not* of Lam.). K. Martin (75), pp. 98, 122, 123.

Coast near mouth of river Tji Lamaja, 6 specimens of the typical form and three, belonging to the higher form, called *morbidum* by Reeve.

Distribution: Between Padang and Indrapura (West Coast of Sumatra), Billiton.

— Singapore, Malacca, Mergui Archipelago, Cochin China, Annam, China, Japan. — Ceylon. — Mauritius.

Fossil in the Pliocene of Java (Resid. Bantam).

According to Crosse and Fischer *Crucibulum extinctorium* of authors is not the species meant by Lamarck, in consequence they have renamed it.

FAM. **NATICIDAE.**

48. **Natica (s. str.) maculosa** Lamarck.

Figure 6.

1781 *Pellis tigrina*. Chemnitz, Conchylien-Cabinet, vol. V, p. 265, pl. 187, figs. 1892, 1893.
1791 *Nerita canrena*, var. ω. Gmelin (*not* Linné), Syst. Nat., edit. XIII (27), p. 3670.
1817 *Nerita canrena*, var.. Dillwyn (*not* Linné), A descriptive Catalogue of recent shells, vol. II, p. 977.
1822 *Natica maculosa*. Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 202, nr. 22.
— — *Javanica*. Lamarck, ibid., p. 204, nr. 30.
1838 *Natica maculosa*. Lamarck, An. s. vert. (53), vol. VIII, p. 641.
— *Javanica*. Lamarck, ibid., p. 644.
1841 *Natica maculosa*. B. Delessert, Recueil des Coquilles décrites par Lamarck dans son Histoire des Anim. sans Vertèbres, et non encore figurées, pl. 32, figs. 14 a, 14 b.
— — *Javanica*. B. Delessert, ibid., pl. 32, figs. 16 a, 16 b.
1850 *Natica pellis tigrina*. Philippi, Natica u. Amaura (90), p.20, pl. 2, figs. 19, 20; pl. 15, figs. 1, 2.
1855 *Natica maculosa*. Reeve (97), vol. IX, Natica, pl. XIII, fig. 57.
1860 — — Lamk.. von Martens in: Proceedings Zoological Society of London, p. 17.
1871 *Natica pellis tigrina* Chemnitz. Lischke, Japan. Meeresconch. (59), vol. II, p. 75.
1883 *Natica maculosa*. Sowerby, Thesaurus (106), vol. V, p. 81, pl. 455, fig. 13 (rather bad).
1886 *Natica (s. str.) maculosa*. Tryon (109), vol. VIII, p. 16, pl. 3, fig. 35.
1887 *Natica maculosa*. von Martens, Mergui (67), p. 188.
1889 — — L. Morlet in: Journal de Conchyliologie, vol. XXXVII, p. 155.
1889 — — Crosse et Fischer in: Journ. de Conch., vol. XXXVII, p. 289.

1891 *Natica maculosa*. P. Fischer, Indo-Chine (22), p. 194 (110).
1905 — — Dautzenberg et H. Fischer, Tonkin (17), pp. 173—174.
1905 *Natica (s. str.) pellis tigrina* Chemn.. K. Martin, Foss. v. Java (73), p. 255.
1908 *Natica (s. str.) maculosa*. Horst et Schepman (31), p. 372.
1909 *Natica maculosa*. Lamy, Java (56), p. 467.
1911 *Natica pellis tigrina* Chemn.. K. Martin, Vorläuf. Bericht (74), p. 47.
1919 — — — — K. Martin (75), pp. 98, 128, 146.
(Not *Natica pellis-tigrina* of Reeve (figs. 55 a, b) and Sowerby (Thesaurus, fig. 83)).

Coast near mouth of river Tji Lamaja, 10 specimens (figure 6).
Surabaya, Harbour, mud, 2 specimens.
Surabaya (without particular locality), 4 specimens.

Distribution: Recorded several times from Java. As far as I know, the only locality in the Dutch East Indies from which the species has been mentioned besides are the Aru-islands. — Philippines, Southern Japan, Amoy, Hongkong, Tongking, Siam, Singapore (in sandy mud), Salang-island, Mergui and its archipelago (mud- and sand-flats), Ceylon.

Fossil in the Upper Miocene (Tjilanang-beds) and in pleistocene deposits of Java.

In accordance with Dautzenberg and Fischer I have adopted Lamarck's name *maculosa* for this species, the name *Pellis tigrina* of Chemnitz being not binominal.

49. **Natica (Neverita) didyma** Bolten sp..

Figure 7.

1798 *Albula didyma* Bolten. Museum Boltenianum, p. 20.
1845 *Natica papyracea*. von dem Busch in: Philippi, Abbildungen (86), vol. II, p. 45, Natica, pl. II, fig. 14 (junior).
1849 *Natica ampla*. Philippi (88), 5. Jahrg., p. 156.
1849 — *didyma* Bolten. Philippi (90), p. 6, pl. 1, figs. 1—4.
1852 — *ampla*. Philippi, ibid., p. 41, pl. 6, fig. 2.
— — *papyracea*. Philippi, ibid., p. 43, pl. 5, fig. 4; pl. 13, fig. 4.

1855 *Natica Lamarckiana* (Recluz M S.). Reeve (97), vol. IX, Natica, pl. II, figs. 6 a, b.

— — *Chemnitzii* (Recluz M S.). Reeve, ibid., pl. II, figs. 7 a, b.

— — *Petiveriana* (Recluz M S.). Reeve, ibid., pl .V, figs. 17 a, b.

1860 — *robusta*. Dunker in: Malakozoologische Blätter, vol. 6, p. 232.

1861 — — Dunker, Mollusca Japonica, p. 13, pl. 2, fig. 24.

1867 — *bicolor* (*not* of Philippi). L. von Schrenck, Die Mollusken des Amur-Landes und des Nord-japanischen Meeres, p. 378.

1869, 1871 *Natica Lamarckiana*. Lischke, Japan. Meeresconch. (59), vol. I, p. 80; vol. II, p. 74.

1881 — — D. Brauns, Geology of the Environs of Tokio (Memoirs of the Science Department, University of Tokio, nr. 4), p. 30.

1883 *Natica didyma* Bolten. Sowerby, Thesaurus (106), vol. V, p. 77, pl. 454, fig. 4; pl. 455, fig. 14.

1884 *Natica (Neverita) didyma* Bolten. K. Martin (72), p. 165.

1886 — — *ampla*. Tryon (109), vol. VIII, p. 32, pl. 10, figs. 81—83, 85, 86; pl. 11, figs. 91—95; pl. 12, fig. 6.

1886 — — *didyma* Bolten. Boog Watson, Challenger Gasterop. (8), p. 450.

1887 — — *Chemnitzii* Récluz. von Martens, Mergui (67), p. 188.

1895 *Polinices (Neverita) ampla*. Pilsbry, Catalogue of the marine mollusks of Japan, p. 72.

1905 *Natica (Neverita) ampla* Philippi. K. Martin, Foss. v. Java (73), p. 262, pl. XXXIX, figs. 628, 629.

1906 — *ampla*. Tokunaga, Fossils from the Environs of Tokyo (Journal of the College of Science, Imperial University of Tokyo, vol. XXI, Art. 2), p. 18, pl. I, fig. 32.

— — *papyracea*. Tokunaga, ibid., p. 19, pl. I, fig. 33.

1908 — *(Neverita) ampla* and vars. *Chemnitzii* and *petiveriana*. Horst et Schepman (31), p. 376.

1911 *Natica (Neverita) ampla.* H. Martin—Icke, Trinil (76), p. 47.
1919 *Natica ampla.* K. Martin (75), pp. 99, 125, 126, 132.
1920 *Polinices (Neverita) ampla.* Yokoyama (115), p. 77, pl. V, figs. 5, 6.
1922 — — — Yokoyama (116), p. 84.

Surabaya, Harbour, mud, 1 bleached specimen (figure 7).
Tjilatjap (Leyden Museum).
Distribution: New Guinea, Waigeu and Misol. — Sydney (New South Wales). — Philippines; Japan, also Yezo, Northern Japan; China; Further India and Malacca; Nicobar Is., Bay of Bengal, Coromandel Coast, Ceylon; Persian Gulf; Madagascar.
Fossil in the Upper Miocene and Pliocene of Java, also in the Pliocene of Japan.

My specimen from Surabaya belongs to the flatter form, called *petiveriana* by Reeve.

50. **Natica (Polinices) mamilla** Linné sp..

1705 *Valvata septima sive albula.* Rumphius (100), p. 76, pl. XXII, fig. F.
1758 *Nerita mamilla.* Linné, Systema Naturae, edit. X, p. 776.
1767 — — Linné, Syst. Nat., edit XII, p. 1252.
1822 *Natica mamilla.* Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 197, nr. 4.
1823 *Natica mammilla.* Sowerby, Genera (105), Natica, fig. 2.
1838 *Natica mamilla.* Lamarck, An. s. vert. (53), vol. VIII, p. 630.
1843 — *pyriformis.* Recluz in: Proceedings Zoological Society, London, 1843, p. 211.
1851 *albula.* Recluz in: Journal de Conchyliologie, vol. II, p. 194.
1852 — *mamilla.* Philippi, Natica u. Amaura (90), p. 31, pl. 4, figs. 7, 8.
— — *pyriformis.* Philippi, ibid., p. 60, pl. 9, fig. 8.
1855 — *pyriformis* Recl.. Reeve (97), vol. IX, Natica, pl. V, fig. 16.
— — *albula* Recl.. Reeve, ibid., pl. VI, figs. 23 a, b.
— — *mamilla* Lam.. Reeve, ibid., pl. VII, figs. 27 a, b.
1871 — *pyriformis* Recl.. Lischke, Japan. Meeresconch. (59), vol. II, p. 169.

1874 *Natica pyriformis* Recl., Lischke, ibid., vol. III, p. 53.
1883 — *mamilla*. Sowerby, Thesaurus (106), vol. V, p. 85, pl. 456, figs. 28—30.
1886 — *(Mamma) mamilla*. Boog Watson, Challenger Gasterop. (8), p. 452.
1886 — — — Tryon (109), vol. VIII, p. 49, pl. 16, fig. 46.
1887 — *(Polinices) mammilla*. von Martens, Mergui (67), p. 188.
1897 — *mamilla*. von Martens (69), p. 291.
1899 — — Dautzenberg, Sumatra (15), p. 4.
1901 — — L. sp.. H. Fischer, Djibouti, etc. (22*a*), p. 120.
1902 — *(Polinices) mammilla*. von Martens, Rumphius Gedenkboek (71), p. 114.
1903 — *(Mamma) mamilla* Lm.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 256, 276—277.
1905 — *(Polinices) mamilla*.K. Martin, Foss. v. Java (73), p. 263.
1908 — *(Pollinices) mamilla*. Horst et Schepman (31), p. 379.
1909 — *(Mamma)* — Schepman (104), p. 215.
1909 — *mamilla*. Lamy, Java (56), p. 467.
1911 — — K. Martin, Vorläuf. Bericht (74), p. 47.
1911 — *(Polinices) mamilla* Lam.. H. Martin—Icke, Trinil (76), p. 47.
1919 — *mamilla* Linn.. K. Martin (75), pp. 99, 122, 123, 128, 132, 142, 146.
1920 — — L.. Tesch, Timor (108), II, p. 71, pl. CXXXIII, figs. 209, 210.
1923 — *(Mama) mamilla* L.. Henrich, Meeresmoll. Sinai (28*a*), p. 73.

Coral-island Pulu Pandjang, 2 worn specimens. North coast of Residency Besuki, East Java (Leyden Museum).

Tjilatjap (Leyden Museum).

Anjer, coast of Sunda-strait (von Martens (71)).

Distribution: East Indian Archipelago: Padang (Sumatra), Banka, Celebes, Sumbawa, Flores, Adonara, Timor, Wetter, Amboina, Ceram, Bachan, East coast of Halmahera (Museum Wageningen), Misol, Kei Is..

— Torres Straits, Australia. — Philippines, Japan, Hong-

kong. — Singapore, Mergui Archipelago. — Nicobars, Andamans, Ceylon and the whole Indian Ocean to the Red Sea and the African Coast, southward to Natal.

Fossil in the Upper Miocene, Pliocene and Pleistocene of Java and the Pliocene of Timor.

51. **Natica (Mammilla) melanostomoides** Quoy et Gaimard.

Figure 8.

1832 *Natica melanostomoïde.* Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. II, pp. 229—230, pl. 66, figs. 4—8.
1838 *melanostomoides* Quoy. Deshayes in Lamarck (53), vol. VIII, p. 652.
1852 — — Philippi, Natica u. Amaura (90), p. 58, pl. 9, fig. 5.
1855 — — Reeve (97), vol. IX, Natica, pl. XXII, fig. 101.
1883 — — Quoy. Sowerby, Thesaurus (106), vol. V, p. 97, pl. 459, fig. 78.
1886 — *(Mamilla) melanostoma* Gmel., var. *melanostomoides.* Tryon (109), vol. VIII, p. 50, pl. 22, fig. 21.
1908 — — — — var. *melanostomoides.* Horst et Schepman (31), p. 381.
1909 — — *melanostomoides.* Schepman (104), p. 216.

Shore of Bali-strait, north of Banjuwangi, 1 specimen (figure 8).

Distribution: Malay Archipelago and Melanesia: Banka, Sumbawa, Flores, Makassar, Talaut Is. (N. E. of Celebes), New Guinea, New Ireland.

FAM. **CERITHIIDAE.**

52. **Cerithium concisum** Hombron et Jacquinot.

Figures 9, 10.

1822 *Cerithium morus.* Lamarck (*non* Bruguière), An. s. vert. (52), vol. VII, p. 75, nr. 29.

1834 *Cerithium morus* Lk.. Quoy et Gaimard, Voyage de découvertes de l'Astrolabe (96), vol. III, p. 118, pl. 54, figs. 13—15.
1838 — — — Potiez et Michaud, Galérie des Mollusques, ou Catalogue méthodique, descriptif et raisonné des mollusques et coquilles du Muséum de Douai, I, p. 366, pl. 31, figs. 25—26.
1841 *Cerithium concisum*. Hombron et Jacquinot, Voyage au Pôle Sud, pl. 24, figs. 1, 2.
1841-'42 *Cerithium morus*. Kiener (32), vol. V, Cerithium, p. 52, pl. 15, fig. 1.
1843 *Cerithium morus*. Lamarck, An. s. vert. (53), vol. IX, p. 302.
1854 *Cerithium obscurum*. Rousseau in Hombron et Jacquinot, Voyage au Pôle Sud, p. 102.
1855 *Cerithium morus* Lk.. Sowerby, Thesaurus (106), vol. II, p. 870, pl. 182, figs. 159—161.
1865 — — — Reeve (97), vol. XV, Cerithium, species 42, pl. VII, fig. 42.
1887 — — — Tryon (109), vol. IX, p. 133, pl. 24, figs. 32, 33.
1887 *Cerithium morum* Lam.. von Martens, Mergui (67), p. 191.
1890 *Cerithium morus* Lam.. Kobelt, Cerithium (35), p. 80, pl. 15, figs. 6, 7.
1891 — — — P. Fischer, Indo-Chine (22), p. 161 (reprint, p. 77).
1897 *Cerithium morum*. von Martens (69), p. 172.
1899 *Cerithium morus* Lam.. Melvill and Standen, Torres Straits (77), p. 167.
1899 — — — Horst et Schepman (31), p. 228.
1900 — — — Dautzenberg, Sumatra (15), p. 4.
1903 — — — Sturany, Gastropoden des Rothen Meeres (107a), pp. 261, 278—279.
1905 *Cerithium concisum* Hombr. et Jacq.. Dautzenberg et H. Fischer, Tonkin (17), pp. 124, 125, 132.
1906 — — — — — Dautzenberg et H. Fischer (18), p. 408.
1907 — — — — — Couturier, Tahiti, etc. (13), p. 155.
1909 *Cerithium morum* Lam.. Schepman (104), p. 160.
1923 — *morus* Lam.. Henrich, Meeresmoll. Sinai (28*a*), p. 72.

Coral-island Pulu Pandjang, 1 specimen (figure 9).

Shore of Bali-strait, north of Banjuwangi, 1 specimen (figure 10).

Anjer, coast of Sunda-strait (von Martens). Island Enkhuizen near Batavia (Museum Amsterdam).

Distribution: East Indian Archipelago: Sumatra (Padang, Benkulen), Banka, Lombok, Sumbawa, Paternoster and Postillon-islands, Rotti, Timor, Amboina, Ceram, Bachan, Togean Is. near Celebes.

– Philippines, South Japan, Hongkong, Pulo Kondor, Siam, Singapore, Mergui Archipelago, Bengal, Bombay, Persian Gulf, Red Sea, Seychelles, Mauritius, Madagascar. — Torres Straits, New Britian, Solomon Is., Vanikoro, Paumotu.

According to Dufo [1]) this species lives in groups in sandy mud between high and low-water level.

52a. **Cerithium concisum moniliferum** (Dufresne) Kiener.

1841-'42 *Cerithium moniliferum* Dufresne. Kiener (32), vol. V, Cerithium, p. 49, pl. 16, fig. 3.

1843 — — Kiener. Deshayes in Lamarck (53), vol. IX, p. 319.

1855 — — Kiener. Sowerby, Thesaurus (106), vol. II, p. 870, pl. 182, figs. 163, 165.

1865 — — Reeve (97), vol. XV, Cerithium, species 20, pl. IV, fig. 20.

1887 *Cerithium morus* Lam., pars. Tryon (109), vol. IX, p. 134, pl. 24, fig. 35.

1890 *Cerithium moniliferum* Kien.. O. Boettger (5), p. 166.

1893 *Cerithium (s. str.) moniliferum* Kiener. Kobelt (35), p. 126, pl. 24, figs. 2, 3.

1895 *Cerithium morus* Lam., var. *moniliferum* Dufresne. Schepman (102), p. 162.

1899 *Cerithium morus*, var. *moniliferum* Dufresne. Horst et Schepman (31), p. 228.

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1) H. Dufo, Observations sur les mollusques marins, terrestres et fluviatiles des îles Sèchelles et des Amirantes (Annales des Sciences Naturelles, 2e série, vol. 14, Zoologie; Paris, 1840), p. 61.

1899 *Cerithium moniliferum* Dufresne, *in* Kiener. Dautzenberg, Sumatra (15), p. 4.
1903 — — Dufr.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 261, 279.
1909 *Cerithium morum*, var. *monilifera* Kiener. Schepman (104), p. 161.

Coral-island Pulu Pandjang, 4 specimens.

Thousand Is., north of Batavia (Strubell). Sunda-strait (Leyden Museum). Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Padang (Sumatra), Coast of Sambas (Borneo), Lombok, Flores, Timor. — Philippines, Japan. — Red Sea, Nossi-Bé near Madagascar. — Samoa.

53. **Potamides (Tympanotonos) cingulatus** Gmelin sp..

Figure 11.

1780 *Turbo granulatus minor* etc.. Martini, Conchylien-Cabinet, vol. IV, p. 328, pl. 157, fig. 1492.
1791 *Murex cingulatus*. Gmelin, Syst. Nat. (27), p. 3561.
1798 *Strombus Picta*. Bolten, Museum Boltenianum, p. 97.
1838 *Cerithium fluviatile*. Potiez et Michaud, Galérie des Mollusques, ou Catalogue méthodique, descriptif et raisonné des mollusques et coquilles du Muséum de Douai, I, p. 363, pl. 31, figs. 19, 20.
1841 — *incisum*. Hombron et Jacquinot, Voyage au Pôle Sud, pl. 23, figs. 8, 9.
1841-'42 *Cerithium fluviatile*. Kiener (32), vol. V, Cerithium, p. 92, pl. 29, fig. 3.
1843 — — Deshayes in Lamarck (53), vol. IX, p. 320.
1852 *cingulatum* Gm.. Mörch, Catalogus Yoldi, p. 57.
1854 — *incisum*. Rousseau in Hombron et Jacquinot, Voyage au Pôle Sud, p. 97.
1855 — *fluviatile*. Sowerby, Thesaurus (106), vol. II, p. 891, pl. CLXXXVI, figs. 296, 298.
1866 *Tympanotonos fluviatilis*. Reeve (97), vol. XV, Tympanotonos, pl. II, figs. 9 a, b.

1869, 1871 *Potamides fluviatilis*. Lischke, Japan. Meeresconch. (59), vol. I, p. 76; vol. II, p. 69.
1887 *Potamides (Tympanotonos) fluviatilis*. Tryon (109), vol. IX, p. 159, pl. 31, fig. 38.
1887 — *(Cerithidea) fluviatilis*. von Martens, Mergui (67), p. 169.
1891 — *fluviatilis* P. et M.. P. Fischer, Indo-Chine (22), p. 163 (reprint, p. 79).
1897 — *(Tympanotonos) cingulatus* Gm.. von Martens (69), p. 183.
1899 *(Cerithidea) fluviatilis*. Horst et Schepman (31), p. 235.
1905 *Tympanotomus cingulatus* Gmel.. Dautzenberg et H. Fischer (17), pp. 132—134.
1906 — — — Dautzenberg et H. Fischer (18), p. 410.
1909 *Potamides (Tympanotonos) fluviatilis*. Schepman (104), p. 168.
1909 *Potamides fluviatilis*. Lamy, Java (56), p. 467.
1914 — *cingulatus*. Leschke, Java und Celebes (58), p. 259.
1920 *Potamides (Tympanotonos) fluviatilis*. Yokoyama (115), p. 68, pl. IV, fig. 14.
1921 — — *cingulatus*. Prashad, Sumatra (95), p. 494.
1922 — — *fluviatilis*. Yokoyama (116), p. 71.

Coast near mouth of river Tji Lamaja, 2 specimens (figure 11).

Near Surabaya (von Martens). Near reef of Batjulmati, East coast (Siboga exp.). Near Banjuwangi (von Martens).

Distribution: Widely spread throughout the Indian Archipelago: Sumatra, Banka, Borneo, Celebes, Lombok, Sumbawa, Ceram.

— Philippines, Nagasaki (Japan), Amoy, Hongkong and Macao, Tongking, Annam, Cochin China, Siam, Singapore, Salang-island (Malacca), Mergui Archipelago, Nicobars, Ganges Delta, Coromandel Coast, Ceylon, Malabar Coast. — North West Coast of Australia.

Fossil in the Pliocene (Musashino) of Japan.

Potamides cingulatus is essentially a form of brackish water, it occurs in mangrove-swamps, lagoons and estuaries. An-

derson found it in the Mergui-Archipelago on trunks of mangrove-trees and on sand below them, immediately below high-water mark.

54. **Potamides (Telescopium) telescopium** Linné sp..

1758 *Trochus telescopium*. Linné, Systema Naturae, edit. X, p. 760.
1767 — — Linné, Systema Naturae, edit. XII, p. 1231.
1792 *Cerithium telescopium*. Bruguière, Encycl. (10), vol. I, part 2, p. 485, nr. 17.
1810 *Telescopium indicator*. Montfort, Conchyliologie systématique, vol. II, p. 438.
1817 *Telescopium fuscum*. Schumacher, Essai d'un nouveau Système des habitations des Vers testacés (104*a*), p. 233.
1822 *Cerithium telescopium*. Lamarck, An. s. vert. (52), vol. VII, p. 67, nr. 4.
1834 — — Quoy et Gaimard, Voyage de découvertes de l'Astrolabe (96), vol. III, p. 125, pl. 55, figs. 4—6.
1841-'42 *Cerithium telescopium*. Kiener (32), vol. V, Cerithium, p. 88, pl. 28, fig. 1.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 286.
1855 — — Sowerby, Thesaurus (106), vol. II, p. 890, pl. CLXXXV, fig. 269.
1859 *Cerithium (Telescopium) telescopium* Brug.. Chenu (11), vol. I, p. 286, fig. 1930.
1865 *Telescopium fuscum* Schumacher. Reeve (97), vol. XV, Telescopium, species 1.
1884 *Potamides (Telescopium) telescopium* Brug.. K. Martin (72), p. 145.
1887 — — — Tryon (109), vol. IX, p. 161, pl. 33, fig. 56.
1890 *Telescopium fuscum* (Schum.). O. Boettger (5), p. 167.
1890 *Cerithium (Telescopium) telescopium*. Kobelt (35), p. 57, pl. 12, fig. 1.
1897 *Potamides (Telescopium) telescopium* L.. von Martens (69), p. 180.
1899 *Telescopium telescopium*. K. Martin (73), p. 220, pl. XXXIII, fig. 509.

1899 *Potamides (Telescopium) telescopium.* Horst et Schepman (31), p. 234.
1914 — *telescopium.* Leschke, Java und Celebes (58), p. 259.
1919 *Telescopium telescopium.* K. Martin (75), pp. 94, 128, 137, 147.
1920 — — Tesch, Timor (108), II, p. 58, pl. CXXXII, fig. 191.
1921 *Potamides (Telescopium) telescopium.* Prashad, Sumatra (95), p. 493.

Surabaya, Harbour, mud, 4 specimens.
One specimen is covered with *Ostrea*.
Mangrove-swamps at Tandjong Priok near Batavia (Strubell).

Distribution: East Indian Archipelago: Mangrove-swamps in Sumatra (Deli and Serdang) and Borneo, Timor, Amboina, Ceram (mangrove-swamps), Buru, New Guinea. — North Western Australia. — Philippines, Singapore (in brackish ditches), Salang-island (Malacca), Burma in estuaries, Nicobars, India (Gangetic Delta; lagoon near Madras), Ceylon, Réunion, Madagascar.

Fossil: Miocene of Java; Pliocene of Nias near Sumatra; Pliocene and Pleistocene of Timor; Pleistocene of Madura, Celebes and New Guinea.

55. **Potamides (Cerithidea) obtusus** Lamarck sp..

Figure 12.

1822 *Cerithium obtusum.* Lamarck, An. s. vert. (52), vol. VII, p. 71, nr. 17.
1828 *Strombus obtusus.* W. Wood, Supplement to the Index Testaceologicus, pl. 4, fig. 8.
(? 1834) *Cerithium decollatum* (*not* of Bruguière). Sowerby, Genera (105), Cerithium, fig. 2.
1841-'42 *Cerithium obtusum* Lam.. Kiener (32), vol. V, Cerithium, p. 95, pl. 29, fig. 1.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 294.
1855 — — Lam.. Sowerby, Thesaurus (106), vol. II, p. 885, pl. 186, fig. 271.
1866 *Cerithidea obtusa* Wood. Reeve (97), vol. XV, Cerithidea, sp. 4, pl. I, figs. 4 a, b.

1887 *Potamides (Cerithidea) obtusa* Lam.. Tryon (109), vol. IX, p. 161, pl. 33, figs. 59, 60.
1887 — — *obtusus* Sow.. von Martens, Mergui (67), p. 168.
1890 *Cerithium (Cerithidea) obtusum* Wood. Kobelt, Cerithium (35), pp. 42, 43, pl. 9, figs. 3—5.
1897 *Potamides (Cerithidea) obtusus* Lam.. von Martens (69), p. 186, pl. IX, figs. 22, 22b.
1899 *Potamides (Cerithidea) obtusus* Wood. Horst et Schepman (31), p. 234.
1903 *Cerithidea obtusa*, Lam.. Dautzenberg, Sambas (16*a*), p. 6.
1921 *Potamides (Cerithidea) obtusum* (Lam.). Prashad, Sumatra (95), p. 495.

Coast near mouth of river Tji Lamaja, 3 specimens (figure 12).

Distribution: Malay Archipelago: Deli and Serdang (Sumatra) in mangrove-swamps and mouth of river, Borneo (Sambas-river and Pleihari), Celebes, Timor.
— Cochin China, Siam, Singapore (mud-flat exposed at low tide), Malacca, Pulu Penang (in brackish puddles), Salang-island, Mergui Archipelago (on mangroves), Calcutta. — Madagascar.

FAM. **STROMBIDAE.**

56. **Pterocera lambis** Linné sp..

1705 *Cornuta*. Rumphius (100), p. 110, pl. XXXV, figs. E, F; pl. XXXVI, fig. G.
1758 *Strombus lambis*. Linné, Systema Naturae, edit. X, p. 743.
1767 — — Linné, Syst. Naturae, edit. XII, p. 1208.
1789 *Strombus camelus*. Chemnitz, Conchylien-Cabinet, vol. X, pl. 155, fig. 1478.
1791 *Strombus lambis*. Gmelin, Syst. Nat. (27), p. 3508, nr. 5.
1822 *Pterocera lambis*. Lamarck, An. s. vert. (52), vol. VII, p. 196, nr. 2.
1834 *Strombus Lambis* (Linné). Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, pp. 61—63, pl. 50, fig. 6.
1842 *Pteroceras Lambis* Lin.. Sowerby, Thesaurus (106), vol. I, p. 41, pl. XI, figs. 5—7.

1843 *Pterocera lambis*. Lamarck, An. s. vert. (53), vol. IX, pp. 672—673, nr. 2.
1843-'44 — *Lambis* Lam.. Kiener (32), vol. IV, Pterocera, p. 7, pl. 3; pl. 9, fig. 2; pl. 4, fig. 1.
1846 — *lambis*. Küster (44), p. 82, pl. 10, fig. 7; pl. 16, figs. 3, 4; pl. 17, fig. 3; pl. 18, figs. 5, 6.
1851 — — Linnaeus. Reeve (97), vol. VI, Pterocera, species 8, pl. V, fig. 8.
1885 *Pterocera (Heptadactylus) lambis*. Tryon (109), vol. VII, p. 124, pl. 8, figs. 1—3.
1887 *Pterocera lambis* L.. von Martens, Mergui (67), p. 190.
1899 *Pterocera (Heptadactylus) lambis* L.. Melvill and Standen, Torres Straits (77), p. 166.
1899 *Pterocera lambis* L.. Horst et Schepman (31), p. 220.
1902 — — — von Martens, Rumphius Gedenkboek (71), p. 122.
1907 — — — Couturier, Tahiti, etc. (13), p. 154.
1909 — — — Schepman (104), p. 153.

Shore of Bali-strait, north of Banjuwangi, fragments.
Bay of Popoh, South coast, Residency Kediri, 1 worn specimen.
Near reef of Batjulmati, East coast (Siboga expedition).
Distribution: East Indian Archipelago: Sumatra, Banka, Billiton, Borneo-bank, Celebes, Kangeang (east of Madura), Flores, Roma-island near Timor, Timor, Amboina, Nusa-Laut-island near Amboina, Obi, Halmahera (Museum Wageningen), Waigeu, Kei-islands, New Guinea, Torres Straits.
— Philippines, Singapore, Mergui Archipelago, Nicobars, Ceylon, Red Sea, Zanzibar, Madagascar. — Vanikoro (Melanesia), Tonga, Society Is., Paumotu.

57. **Pterocera (Millepes) scorpio** Linné sp..

1705 *Cornuta nodosa*. Rumphius (100), pl. XXXVI, fig. K.
1758 *Strombus scorpius*. Linné, Systema Naturae, edit. X, p. 743.
1767 — — Linné, Syst. Nat., edit. XII, p. 1208.
1822 *Pterocera scorpio*. Lamarck, An. s. vert. (52), vol. VII, p. 197, nr. 5.
1842 *Pteroceras* — Sowerby, Thesaurus (106), vol. I, p. 43, pl. XI, fig. 1.

1843 *Pterocera scorpio*. Lamarck, An. s. vert. (53), vol. IX, pp. 674—675, nr. 5.
1843-'44 — — Kiener (32), vol. IV, Pterocera, p. 13, pl. 6.
1846 — *Scorpio*. Küster (44), p. 87, pl. 14, fig. 7.
1851 — *scorpius*. Reeve (97), vol. VI, Pterocera, species 3, pl. III, fig. 3.
1885 *Pterocera (Millipes) scorpio*. Tryon (109), vol. VII, p. 125, pl. 9, fig. 6.
1899 — *(s. str.) scorpio* L.. Horst et Schepman (31), p. 221.
1902 — *scorpius* L.. von Martens, Rumphius Gedenkboek (71), p. 122.

Coral-island Pulu Pandjang, 1 worn specimen.
Distribution: Eastern part of the Archipelago: Timor, Rotti, Amboina. Haruku, Saparua and Nusa-Laut near Amboina, Ceram, Obi, Waigeu.
— Philippines. — Madagascar.

58. **Pterocera** (**Harpago**) **chiragra** Linné sp..

1705 *Harpago*. Rumphius (100), p. 109, pl. XXXV, figs. A—D.
1758 *Strombus chiragra*. Linné. Systema Naturae, edit. X, p. 742.
1767 — — Linné, Syst. Nat., edit. XII, p. 1207.
1822 *Pterocera chiragra*. Lamarck, An. s. vert. (52), vol. VII, p. 198, nr. 7.
1842 *Pteroceras Chiragra*. Sowerby, Thesaurus (106), vol. I, p. 42, pl. XI, fig. 12.
1843 *Pterocera chiragra*. Lamarck, An. s. vert. (53), vol. IX, pp. 675—677, nr. 7.
1843-'44 — — Lam.. Kiener (32), vol. IV, Pterocera, p. 5, pl. 5; pl. 10, fig. 2.
1846 — — Linné. Küster (44), pp. 91—92, pl. 16, figs. 1, 2; pl. 17, figs. 1, 2; pl. 18, figs. 3, 4, 7, 8.
1851 — — Reeve (97), vol. VI, Pterocera, species 2, pl. II, fig. 2.
1885 *Pterocera (Harpago) chiragra* L.. Tryon (109), vol. VII, p. 126, pl. 10, fig. 13.
1899 — — — — Horst et Schepman (31), p. 221.

1902 *Pterocera chiragra* L.. von Martens, Rumphius Gedenkboek (71), p. 122.
1909 — — – Schepman (104), p. 154.
1909 — — – Lamy, Java (56), p. 467.

Bay of Popoh, South coast, Resid. Kediri, 2 specimens.

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Billiton, Timor, Banda, Amboina, Nusa-Laut-island near Amboina, Ceram, Bonoa and Manipa between Ceram and Buru, Morotai, Waigeu, Kei-islands.
— Philippines, New Caledonia, Polynesia.

59. **Strombus canarium** Linné.

1705 *Epidromis gibbosa*. Rumphius (100), p. 110, pl. XXXVI, fig. N.
1758 *Strombus canarium*. Linné, Systema Naturae, edit. X, p. 745.
1767 — — Linné, Syst. Nat., edit XII., p. 1211.
1791 — — Gmelin, Syst. Nat., edit. XIII (27), p. 3517, nr. 24.
1822 — — Lamarck, An. s. vert. (52), vol. VII, pp. 206—207, nr. 17.
— — *Isabella*. Lamarck, ibid., vol. VII, p. 207, nr. 18.
1832 — *canarium*. Deshayes, Encyclopédie méthodique; Vers, vol. III, p. 990.
1834 — *Canarium*. Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, p. 72, pl. 51, figs. 10—11.
— — *vanikorensis*. Quoy et Gaimard, ibid., pp. 73—74, pl. 51, figs. 7—9.
— — *taeniatus*. Quoy et Gaimard, ibid., pp. 75—76, pl. 51, figs. 14—15.
1842 — *canarium*. Sowerby, Thesaurus (106), vol. I, p. 33, pl. VIII, figs. 69, 70.
— — *isabella*. Sowerby, ibid., p. 33, pl. VIII, figs. 68, 71.
1843 — *isabella*. Kiener (32), vol. IV, Strombus, p. 32, pl. 25, fig. 2.
— — *canarium*. Kiener, ibid., p. 33, pl. 29, figs. 1, 1a.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 699.

1843 *Strombus Isabella.* Lamarck, ibid., p. 700.
1845 — — Küster, Strombea (44), p. 41, pl. 7, fig 3.
— — *Canarium.* Küster, ibid., p. 43, pl. 7, fig. 4.
1851 — *canarium.* Reeve (97), vol. VI, Strombus, pl. XVIII, figs. 46 a, b.
— — *Isabella.* Reeve, ibid., pl. XVIII, fig. 51.
1874 — — Lischke, Japan. Meeresconch. (59), vol. III, p. 19.
1885 *Strombus canarium* and var. *Isabella.* Tryon (109), vol. VII, p. 110, pl. 2, figs. 18—20; pl. 3, fig. 21.
1886 *Strombus (Gallinula) canarium.* Boog Watson (8), p. 418.
1887 — *canarium.* von Martens, Mergui (67), p. 189.
1889 — *Isabella.* L. Morlet in: Journal de Conchyliologie, vol. XXXVII, p. 142.
1890 — — Crosse et Fischer in: Journ. de Conch., vol. XXXVIII, p. 15.
1891 — — Paul Fischer, Indo-Chine (22), p. 258 (reprint, p. 174).
1897 — *canarium.* von Martens (69), p. 291.
1899 — *(Gallinula) canarium.* Melvill and Standen, Torres Straits (77), p. 165.
— — — *isabella.* Melvill and Standen, ibid., p. 165.
1899 — *(s. str.) canarium* and var. *vanikorensis.* Horst et Schepman (31), p. 213.
— — — *isabella* and var. *taeniatus.* Horst et Schepman, ibid., p. 213.
1899 — — *isabella.* K. Martin, Foss. v. Java (73), p. 184.
1902 *canarium* L.. von Martens, Rumphius Gedenkboek (71), p. 122.
1905 *Isabella* Lam.. Dautzenberg et H. Fischer, Tonkin (17), pp. 123—124.
1907 — *isabella* Lam.. Schepman, Posttertiär Celebes (102a), p. 185.
1908 — *(Strombus) canarium* L.. O. Boettger (6 a), pp. 668, 669.
1909 — *canarium.* Schepman (104), p. 146.
— — *isabella.* Schepman, ibid., p. 146.
1919 — — K. Martin, Palaeoz. Kenntn. Java (75), p. 147.

1920 *Strombus isabella* (*not* of Lamarck). Tesch, Timor (108), II, p. 48, pl. CXXIX, fig. 165.

Shore near Panarukan, north coast of Resid. Besuki, 2 worn specimens (typical *canarium*).

Djangkar, north coast of Besuki *(isabella)* (Siboga expedition).

Tjilatjap *(isabella)* (Leyden Museum).

Distribution: East Indian Archipelago: Benkulen (Sumatra), Banka, Borneo, Saleyer, Celebes, Lombok, Flores, Timor, Amboina, Bachan, Halmahera (Museum Wageningen), Misol, New Guinea, Torres Straits.

— Vanikoro (Melanesia).

— Philippines, Southern Japan, Cochin China, Singapore, Andamans, Ceylon, Red Sea.

Fossil in the Pleistocene of Madura, Billiton and Northern Celebes (Minahassa) and in the Pliocene of Nias near Sumatra and Timor.

The pliocene fossils from Timor, figured by Dr. Tesch under the name of *Strombus isabella*, surely belong to the typical *canarium*, not to *Str. isabella* of Lamarck. Comparing the latter with *Str. canarium*, Lamarck says: „il s'en distingue d'ailleurs par sa spire, dont tous les tours sont très convexes. Il est, en outre, dépourvu des lignes colorées et flexueuses que l'on observe dans l'autre." The figured fossils from Timor show nothing like these convex whorls, moreover, according to Dr. Tesch, many specimens are showing still traces of the characteristic flexuous brown lines on the last whorl.

For the rest a series of specimens before me shows the gradual transition from the typical *canarium* to the typical *isabella*, both in colour and form. In consequence I agree with the opinion of Tryon, Melvill and Standen and Tesch, that *Strombus isabella* is merely a form of *canarium*.

60. **Strombus (Gallinula) minimus** Linné.

1705 *Epidromis minima*. Rumphius (100), pl. XXXVI, fig. P.
1771 *Strombus minimus*. Linné, Mantissa, p. 549.
1822 *Strombus troglodytes*. Lamarck, An. s. vert. (52), vol. VII, p. 209, no. 23.
1842 *Strombus minimus*. Sowerby, Thesaurus (106), vol. I, p. 28, no. 11, pl. VI, figs. 4, 5.

1843 *Strombus troglodytes* Lamarck. Kiener (32), vol. IV, Strombus, p. 52, pl. 31, fig. 2.
1843 — — Lamarck, An. s. vert. (53), vol. IX, pp. 703—704.
— *Strombus minimus*. Deshayes in Lamarck, An. s. vert. (53), vol. IX, p. 703 (note 2).
1846 — — Küster (44), p. 58, pl. 12, figs. 5, 6.
1851 — — Reeve (97), vol. VI, Strombus, species 47, pl. XVIII, fig. 47.
1885 — *(Gallinula) minimus*. Tryon (109), vol. VII, p. 117, pl. 6, fig. 62.
1899 *Strombus (s. str.) minimus*. Horst et Schepman (31), p. 214.
1899 — — — K. Martin, Foss. v. Java (73), p. 182, pl. XXIX, fig. 421.
1902 *Strombus minimus* L. *(troglodytes* Lam.). von Martens, Rumphius Gedenkboek (71), p. 122.
1919 *Strombus minimus*. K. Martin (75), pp. 91, 141.

Shore of Bali-strait, north of Banjuwangi, 1 specimen.

Distribution: Riouw-archipelago, Banka, Northern Celebes, Flores, Timor, Amboina.
— Philippines. — Viti Is..

Fossil in the Pliocene of Sondé (Resid. Madiun), Java.

61. **Strombus** (**Canarium**) **muricatus** Martini.

1777 *Canarium muricatum*. Martini, Conchylien-Cabinet, vol. III, pp. 85, 98, 165; pl. 78, figs. 803—806.
1817 *Canarium ustulatum*. Schumacher, Essai d'un nouveau système des habitations des vers testacés (104a), p. 219.
1822 *Strombus urceus* (*not* of Linné). Lamarck, An. s. vert. (52), vol. VII, p. 210, no. 25.
1842 — — Sowerby, Thesaurus (106), vol. I, p. 30, pl. VII, figs. 34—36 (*not* 37, 41, 42).
1843 — — Kiener (32), vol. IV, Strombus, p. 60, pl. 15, fig. 2; pl. 30, figs. 2, 3.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 705.
1846 — — Küster (44), pp. 51—53, pl. 9, figs. 4—6 (*not* 7); pl. 14, fig. 9.

1850 *Strombus urceus*. Reeve (97), vol. VI, Strombus, sp. 24, pl. XI, figs. 24 a, b, c.
1859 — — Chenu, Manuel (11), vol. I, p. 257, fig. 1606.
1869 — — Lischke, Japan. Meeresconch. (59), vol. I, p. 30.
1871 — — Lischke, ibid., vol. II, p. 23.
1885 *Strombus (Canarium) urceus*. Tryon (109), vol. VII, p. 118, pl. 6, figs. 65—67.
1886 *Strombus (Canarium) muricatus*. Boog Watson, Challenger Gasterop. (8), p. 417.
1899 — — — Horst et Schepman (31), p. 218.
1906 — *urceus* (*not* of Linné). Dautzenberg et H. Fischer (18), pp. 405—407.
1907 — *muricatus* Martini. Schepman, Posttertiär Celebes (102*a*), p. 186.
1909 — *(Canarium) muricatus*. Schepman (104), p. 151.
1920 *Strombus urceus*. Tesch, Timor (108), II, p. 49, pl. CXXX, fig. 168.

Coral-island Pulu Pandjang, 2 worn specimens. Shore of Bali-strait, north of Banjuwangi, 1 worn specimen.

North coast of Resid. Besuki (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Kangeang-island eastward of Madura, Sumbawa, Flores, Timor, Pulu Barang near Makassar, Amboina, Obi, East coast of Halmahera (Museum Wageningen), West coast of New Guinea. — Torres Straits, New Caledonia, Australia. — Philippines, Nagasaki (Japan), China, Cochin China, Singapore, Ceylon and the Indian Ocean to the Red Sea and the east coast of Africa.

Fossil in the Pliocene of Timor and Nias near Sumatra and in the Pleistocene of Billiton, Makassar and Northern Celebes (Minahassa).

I think *Strombus muricatus* and *Str. dentatus* Linné will prove to be but one species. If this should be right, the species must bear the Linnean name of *Strombus dentatus*.

62. **Strombus (Conomurex) luhuanus** Linné.

1705 *Luhuana*. Rumphius (100), p. 111, pl. XXXVII, fig. S.
1758 *Strombus luhuanus*. Linné, Systema Naturae, edit. X, p. 744.

1767 *Strombus luhuanus*. Linné, Syst. Nat., edit. XII, p. 1209.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 206, nr. 15.
1842 — — Sowerby, Thesaurus (106), vol. I, p. 29, pl. VII, fig. 54.
1843 — — Kiener (32), vol. IV, Strombus, p. 39, pl. 27, fig. 1.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 698.
1846 — — Küster (44), p. 46, pl. 8, figs. 1, 2, 10.
1850 — *Luhuanus*. Reeve (97), vol. VI, Strombus, species 19, pl. IX, fig. 19.
1869 — *luhuanus*. Lischke, Japan. Meeresconch. (59), vol. I, p. 31.
1871 — — Lischke, ibid., vol. II, p. 24.
1885 *Strombus (Conomurex) Luhuanus*. Tryon (109), vol. VII, p. 122, pl. 8, figs. 91, 92.
1899 — — *luhuanus*. Melvill and Standen, Torres Straits (77), p.166.
1899 — — — Horst et Schepman (31), p. 219.
1902 *Strombus Luhuanus*. von Martens, Rumphius Gedenkboek (71), p. 122.
1909 *Strombus (Conomurex) luhuanus*. Schepman (104), p. 153.
1909 *Strombus luhuanus*. Lamy, Java (56), p. 466.
1920 — — Tesch, Timor (108), II, p. 49, pl. CXXX, fig. 167.

Shore near Panarukan, Resid. Besuki, 8 worn specimens.
Shore of Bali-strait, north of Banjuwangi, 2 worn specimens.

Tjilatjap (Leyden Museum). Batavia (Winter).

Distribution: East Indian Archipelago: Banka, Borneobank. Northern Celebes. Sumbawa. Paternoster-islands, Saleyer, Flores. Rotti. Timor. Lucipara-island. Banda. Amboina, Luhu (Ceram). after which the species has been named, Obi. Bachan, Mareh near Tidore, East coast of Halmahera (Museum Wageningen). Waigeu, Misol. Kei Is., New Guinea. — Torres Straits, Western Australia. Queensland, New South Wales. New Caledonia, Viti Is., Tahiti. — Sulu Archipelago, Philippines, Nagasaki (Japan). Hongkong. Singapore. — Seychelles. Amirante Is., Réunion.

Fossil in the Pleistocene of Timor and in deposits in that island, that may be Lower Pleistocene or Upper Pliocene.

FAM. CYPRAEIDAE.

Most species of *Cypraea* found on the Javanese coasts are distributed throughout the whole Indo-Pacific Subregion, ranging from Natal to Southern Japan and Polynesia. Some of them are living also beyond the Indo-Pacific Region, for instance in New Zealand.

63. **Cypraea carneola** Linné.

1705 *Carneola.* Rumphius (100), p. 115, pl. XXXVIII, fig. K.
1758 *Cypraea carneola.* Linné, Systema Naturae, edit. X, p. 719.
1764 — — Linné, Museum Ludovicae Ulricae, p. 568.
1767 — — Linné, Systema Naturae, edit. XII, p. 1174.
1791 — — Gmelin, Syst. Nat. (27), p. 3400, nr. 7.
— — *crassa.* Gmelin, ibid., p. 3421, nr. 108.
1822 — *carneola.* Lamarck, An. s. vert. (52), vol. VII, p. 384, nr. 18.
1837 — — L.. Sowerby, Conchological Illustrations, figs. 165, 165.
1839 — *Sowerbyi.* Anton, Verzeichniss der Konchylien, welche sich in seiner Sammlung befinden (Halle), p. 97.
1844 — *carneola* L.. Lamarck, An. s. vert. (53), vol. X, pp. 505—506.
1845 — — Kiener (32), vol. I, Cypraea, p. 83, pl. 37, fig. 3.
1845 — — L.. Reeve (97), vol. III, Cypraea, species 19, pl. VI, fig. 19, pl. XXVII, fig. 9 b.
1850 — — – Berge, Conchylienbuch (3a), p. 243, pl. 43, fig. 4.
1855 — — Hanley, Ipsa Linnaei Conchylia, p. 183.
1869 — — L.. Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 38.
1870 — — – Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 12, pl. III, figs. 11—13, pl. XXX, fig. 322.
1877 — — – Weinkauff (112), p. 14, pl. 3, figs. 8—9.

1879 *Cypraea propinqua*. Garrett, Annotated catalogue of the species of Cypraeidae collected in the South sea islands (Journal of Conchology, vol. II), p. 116.
1885 — *carneola* L.. Roberts in Tryon (109), vol. VII, p. 166, pl. 3, figs. 26—28.
1899 — *(Aricia) carneola* L.. Horst et Schepman (31), p. 194.
1902 — *carneola* L.. von Martens, Rumphius Gedenkboek (71), p. 122.
1903 — — — Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 299—301.
1903 — — — Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 254, 276—277.
1906-'07 — *Carneola* L.. Hidalgo (30), pp. 190, 293—296.
1907 — *carneola* L.. Couturier, Tahiti, etc. (13), p. 149.
1907 — — — Schepman, Posttertiär Celebes (102a), p. 183.
1909 — — — Schepman, Siboga exp. (104), pp. 126, 231.
1909 — — — Lamy, Java (56), p. 466.
1923 — — — Henrich, Meeresmoll. Sinai (28*a*), p. 73.

Tji Solok, Wijnkoopsbay, 2 specimens of the typical form.

This species has already been recorded from Java by Lamy, but without distinct locality.

Distribution: East Indian Archipelago: Banka, Northern Celebes, Flores, Sumba, Timor, Banda Sea, Amboina, New Guinea.

- Philippines. China, Japan. — Cochin China, Andaman Is., Ceylon, Laccadives, Maldives, Chagos, Persian Gulf, Aden, Red Sea, Gulf of Suez, Gulf of Akabah, East African coasts and islands, South Africa (Durban, Port Elizabeth).

— New Caledonia, Loyalty Is., Micronesia, Polynesia (Sandwich Is., Viti, Tonga, Samoa, Cook Is., Tahiti, Marquesas, Paumotu, Gambier Is.). — North Australia, Queensland, New South Wales.

Fossil in the Pleistocene of Northern Celebes (Minahassa).

64. **Cypraea interrupta** Gray.

1824 *Cypraea interrupta*. Gray, Monogr. Cypr. (28), vol. I, p. 376.

1832 *Cypraea interrupta* Gray. Sowerby, Conchological Illustrations, p. 6, figs. 15, 15.
1844 — — Gray. Deshayes in Lamarck (53), vol. X, p. 564.
1845 — — Kiener (32), vol. I, Cypraea, p. 94, pl. 43, fig. 2.
1846 — — Gray. Reeve (97), vol. III, Cypraea, species 103, pl. XIX, fig. 103.
1865 — *rhinoceros.* Souverbie, Description d'espèces nouvelles de l'Archipel Caledonien (Journ. de Conchyliologie, vol. XIII), p. 156, pl. 5, fig. 1.
1869 — Souv.. Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 45.
1870 — *interrupta* Gray. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 7, pl. XXVII, figs. 271—274, pl. XXXVII, fig. 535.
1880 — — — Weinkauff (112), p. 22, pl. 7, figs. 1, 4.
1885 — — — Roberts in Tryon (109), vol. VII, p. 167, pl. 3, figs. 36, 37; pl. 4, figs. 38, 39.
1899 — — — Horst et Schepman (31), p. 192.
1903 — — — Dautzenberg, Revis. Cypr. Nouv.-Caléd. (16), pp. 302—303.
1906-'07 — — — Hidalgo (30), pp. 139, 204, 386—387.

Tji Solok, Wijnkoopsbay, 2 specimens of the typical form.

Tjilatjap (Leyden Museum).

Distribution: Borneo. — Philippines. — Ceylon. — Solomon Is., New Caledonia, Viti Is., Samoa. — North East Australia.

65. **Cypraea quadrimaculata** Gray.

1824 *Cypraea quadrimaculata.* Gray, Monogr. Cypr. (28), vol. I, p. 376.
1845 — — Kiener (32), vol. I, Cypraea, p. 90, pl. 3, fig. 3.

1846 *Cypraea quadrimaculata* Gray. Reeve (97), vol. III, Cypraea, species 107, pl. XIX, fig. 107.
1847 Porcelaine quadrimaculée. Chenu, Leçons élément. (10a), pl. 11, figs. 15, 16.
1870 *Cypraea quadrimaculata* Gray. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 8, pl. XXVII, figs. 275—277.
1880 — — — Weinkauff (112), pp. 30—31, pl. 9, figs. 1, 4.
1885 — — — Roberts in Tryon (109), vol. VII, p. 167, pl. 4, figs. 40—42.
1899 — — — Horst et Schepman (31), p. 193.
1906-'07 — — — Hidalgo (30), pp. 141, 219, 493—494.
1907 — — — Schepman, Posttertiär Celebes (102a), p. 183.
1909 — — — Schepman, Siboga exp.(104), p. 128.

Coral-island Pulu Pandjang, 4 specimens.
The specimens are worn at the dorsal side, but the brown spots on the extremities are still present.

Distribution: East Indian Archipelago: Borneo, Saleyer, Moluccas.
— Philippines, Cochin China, Singapore, Coromandel Coast, Aden, Mauritius. — Micronesia, Viti Is., Torres Straits, North East Australia.
Fossil in the Pleistocene of Northern Celebes (Minahassa).

66. **Cypraea melvilli** Hidalgo.

1845 *Cypraea ursellus* (*not* of Gmelin). Kiener (32), vol. I, Cypraea, p. 99, pl. 33, figs. 4—4a.
1869 — — (*not* of Gmelin). Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 38.
1870 — *felina* Gmel., var.. Sowerby, Thesaurus (106), vol. IV, Cypraea, pl. XXXII, fig. 393.

1880 *Cypraea felina* Gmel., var.. Weinkauff (112), pp. 42—43, pl. 3, figs. 2—3; pl. 12, figs. 1, 4.
1885 — — — var. *a*. Roberts in Tryon (109), vol. VII, p. 169, pl. 4, figs. 54—55.
1899 — — , var. *ursellus* (*not* of Gmelin). Horst et Schepman (31), p. 193.
1903 *Cypraea ursellus* (*not* of Gmelin). Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), p. 307.
1906-'07 — *Melvilli*. Hidalgo (30), pp. 179, 209, 425—426.
1909 — *ursellus* (*not* of Gmelin). Schepman, Siboga exp. (104), p. 128.

Tji Solok, Wijnkoopsbay, 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: Saleyer (near Celebes).
— Philippines, Nicobar Is., Ceylon, Seychelles, Mauritius, Réunion. — New Caledonia, Caroline Is., Kingsmill, Viti Is., Tonga, Samoa. — New South Wales.

67. **Cypraea stolida** Linné.

1758 *Cypraea stolida*. Linné, Systema Naturae, edit. X, p. 724.
1764 — — Linné, Museum Ludovicae Ulricae, p. 580.
1767 — — Linné, Systema Naturae, edit. XII, p. 1180, nr. 360.
1791 — *rubiginosa*. Gmelin, Syst. Nat. (27), p. 3420, nr. 105.
1822 — *stolida*. Lamarck, An. s. vert. (52), vol. VII, pp. 392—393, nr. 38.
1824 — — Gray, Monogr. (28), vol. I, p. 378, nr. 41.
1836 — — L.. Sowerby, Conchological Illustrations, p. 6, figs. 91, 91, 92.
1844 — — L.. Lamarck, An. s. vert. (53), vol. X, pp. 521—522, nr. 38.
1845 — — Kiener (32), vol. I, Cypraea, p. 23, pl. 31, figs. 1, 1a.
1845 — — L.. Reeve (97), vol. III, Cypraea, species 67, pl. XIV, figs. 67 a, b.
1855 — — Hanley, Ipsa Linnaei Conchylia, p. 194.
1869 — *Crossei*. Marie, Note sur quelques coquilles de la Nouvelle Calédonie (Journ. de Conchyliologie, vol. XVII), p. 16, pl. 1, fig. 3.
1869 — *stolida* L.. Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 47.

1869 *Cypraea Crossei* Marie. Crosse, ibid., p. 47.
1870 — *stolida* L.. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 11, pl. XXX, figs. 327—329.
1877 — — – Weinkauff (112), pp. 5—6 (excl. of *C. erythraeensis)*, pl. 1, figs. 7—8.
1880 — — – Weinkauff, ibid., pp. 36—37 (excl. of *C. brevidentata)*, pl. 11, figs. 1—4.
— — *Crossei* Marie. Weinkauff, ibid., pp. 43—44, pl. 13, figs. 2, 3.
1885 — *stolida* L.. Roberts in Tryon (109), vol. VII, p. 171 (excl. of *C. brevidentata)*, pl. 5, figs. 91, 92; pl. 6, fig. 7.
1903 — — – and var. *Crossei* Marie. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 318—320.
1906-'07 – — – Hidalgo (30), pp. 142, 223, 522—525.
1907 — — – Schepman, Posttertiär Celebes (102a), p. 183.

Coral-island Pulu Pandjang, the only specimen is much worn and entirely bleached; in shape it agrees with the typical form.

Distribution: East Indian Archipelago: Borneo, Amboina. — Philippines. China, Ceylon, Mauritius, Madagascar, Natal, Cape of Good Hope. — New Caledonia, Viti Is., Samoa, Sandwich Is.. — Western Australia.

Fossil in the Pleistocene of Northern Celebes (Minahassa).

68. **Cypraea (Aricia) caput-serpentis** Linné.

1705 Kleine Slangekoppen. Rumphius (100), p. 114, pl. XXXVIII, fig. F.
1758 *Cypraea caput serpentis*. Linné, Systema Naturae, edit. X, p. 720.
1764 — — — Linné, Museum Ludovicae Ulricae, p. 571.
1767 — — — Linné, Systema Naturae, edit. XII, p. 1175.
1791 — — — Gmelin, Syst. Nat. (27), p. 3406, nr. 39.
— — *Reticulum*. Gmelin, ibid., p. 3407, nr. 40.
1822 — *caput serpentis*. Lamarck, An. s. vert. (52), vol. VII, pp. 385—386, nr. 21.

1825 *Cypraea caput serpentis*. Gray, Monogr. (28), vol. I, p. 495.
1834 — — — Quoy et Gaimard, Voyage de l' Astrolabe (96), vol. III, p. 33, pl. 47, figs. 14, 15.
1837 — — — L.. Sowerby, Conchological Illustrations, p. 6, figs. 131, 131.
1844 — — — L.. Lamarck, An. s. vert. (53), vol. X, p. 508—509, nr. 21.
1845 — — — Kiener, (32), vol. I, Cypraea, p. 112, pl. 49, figs. 1, 1a, 1b.
1845 — *caput-serpentis* L.. Reeve (97), vol. III, Cypraea, species 44, pl. XI, fig. 44.
1849 — *caput anguis*. Philippi, Cent. tert. test. nov. (88), VI, p. 24.
1850 — *caput serpentis* L.. Berge, Conchylienbuch (3a), p. 244, pl. 43, fig. 8.
1869 — — — Lischke, Japan. Meeresconch. (59), vol. I, p. 70.
1869 — — — Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 40.
1870 — — — Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 16, pl. XII, figs. 72, 73; pl. XXXVII, fig. 539.
1871 — — — Lischke, Japan. Meeresconch.(59), vol. II, p. 64.
1880 — — — L.. Weinkauff (112), pp. 21—22, pl. 5, figs. 20, 21.
1885 — *(Aricia) caput-serpentis* L.. Roberts in Tryon (109), vol. VII, p. 173, pl. 6, figs. 98—100; pl. 23, fig. 59.
— — *caput-anguis* Phil.. Roberts in Tryon, ibid., p. 206.
1899 — *(Aricia) caput-serpentis* L.. Horst et Schepman (31), p. 198.
1902 — *caput-serpentis* L.. von Martens, Rumphius Gedenkboek (71), p. 122.
1903 — *(Aricia) caput-serpentis* L.. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 322—324.
1906-'07 — *Caput serpentis* L.. Hidalgo (30), pp. 136, 189, 289—293.

1907 *Cypraea caput-serpentis* L.. Couturier, Tahiti, etc. (13), p. 151.
1909 — *(Aricia) caput serpentis* L.. Schepman, Siboga exp. (104), p. 129.
1909 — *caput-serpentis* L.. Lamy (56), p. 466.

Tji Solok, Wijnkoopsbay, 2 specimens.
Java (without exact locality), 4 specimens.
Tjilatjap (Leyden Museum).
Distribution: East Indian Archipelago: Padang (Sumatra), Banka, Borneo, Northern Celebes, Flores, Rotti, Timor, Amboina, Ceram, Obi, Waigeu, Kei Is., Aru Is..
— Philippines, Formosa, Loo-Choo, Japan (also Yezo, Northern Japan), China, Pulo Condor (near Lower Cochin China), Siam, Singapore, Salang, Nicobars, Andamans, Madras, Ceylon, Chagos, Laccadives, Red Sea, East African coasts and islands, Natal, Port Elizabeth (Cape of Good Hope). — New Hebrides, New Caledonia, Micronesia, Sandwich Is., Ellice Is., Viti Is., Tonga, Samoa, Cook Is., Society Is., Marquesas, Paumotu, Gambier-islands. — Queensland, New South Wales, Auckland (New Zealand).

69. **Cypraea (Aricia) arabica** Linné.

1705 *Porcellana Litterata sive Arabica.* Rumphius (100), p. 115, pl. XXXVIII, fig. M.
1758 *Cypraea arabica.* Linné, Systema Naturae, edit. X, p. 718.
— — *fragilis.* Linné, ibid., p. 720.
— — *amethystea.* Linné, ibid., p. 720.
1764 — *arabica.* Linné, Museum Ludovicae Ulricae, p. 566.
— — *fragilis.* Linné, ibid., p. 570.
1767 — *arabica.* Linné, Systema Naturae, edit. XII, p. 1173.
— — *fragilis.* Linné, ibid., p. 1175, nr. 338.
1822 — *arabica.* Lamarck, An. s. vert. (52), vol. VII, pp. 378—379, nr. 7.
1824 — — Gray, Monogr. (28), vol. I, p. 76 (excl. of var.).
1834 — — Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, p. 37, pl. 48, fig. 5.
1836 — — L.. Sowerby, Conchological Illustrations, p. 1, figs. 85, 85.

1844 *Cypraea arabica* Linn.. Lamarck, An. s. vert. (53), vol. X, pp. 495—496.
1845 — — Kiener (32), vol. I, Cypraea, p. 105, pl. 17, fig. 1.
1845 — *Arabica* L.. Reeve (97), vol. III, Cypraea, species 2, pl. I, fig. 2.
1866 — *arabica* – Mabille et Le Mesle, Observations sur la faune malac. de la Cochinchine et du Cambodge (Journal de Conchyliologie, vol. XIV), p. 120.
1869 — — – Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 39.
1869 — — – Lischke, Japan. Meeresconch. (59), vol. I, p. 69.
1870 — *Arabica*. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 15, pl. X, figs. 60—61.
1871 — *arabica*. Lischke, Japan. Meeresconch. (59), vol. II, p. 64.
1880 — — L.. Weinkauff (112), p. 51, pl. 16, figs. 3, 4, 6.
1885 — *(Aricia) Arabica* L.. Roberts in Tryon (109), vol. VII, p. 174, pl. 8, figs. 18, 19.
1889 — *arabica* L.. L. Morlet, Catalogue des coquilles rec. par M. Pavie dans le Cambodge et le royaume de Siam (Journ. de Conchyliologie, vol. XXXVII), p. 139.
1891 — — – P. Fischer, Indo-Chine (22), p. 154 (reprint, p. 70).
1897 — — – von Martens (69), p. 290.
1899 — *(Aricia) arabica* L.. Melvill and Standen, Torres Straits (77), p. 164.
1899 — — — – Horst et Schepman (31), pp. 196—197.
1899 — *arabica* L.. Dautzenberg, Sumatra (15), p. 4.
1902 — *Arabica* L.. von Martens, Rumphius Gedenkboek (71), p. 122.
1903 — *(Aricia) arabica* L.. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 325—327.
1903 — *arabica* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 254, 276—277.
1906 — *(Aricia) arabica* L.. Dautzenberg et H. Fischer (18), pp. 396—397.

1906-'07 *Cypraea Arabica* L.. Hidalgo (30), pp. 136, 185, 260—262.
1909 — *(Aricia) arabica* L.. Schepman, Siboga exp. (104), p. 129.
1909 — *arabica* L.. Lamy, Java (56), p. 466.
1923 — — — Henrich, Meeresmoll. Sinai (28*a*), p. 73.

Coral-island Pulu Pandjang, 4 specimens (much worn), the largest specimen has a length of 70 mm. Java (without exact locality), 4 specimens.

Tjilatjap (Leyden Museum). Island Enkhuizen near Batavia (M. Weber).

Distribution: East Indian Archipelago: Between Padang and Indrapura (Sumatra), Banka, Billiton, Kangeang, Lombok, Paternoster-islands, Flores, Sumba, Savu, Timor, Luciparaisland, Amboina, Ceram, Obi, Halmahera, Celebes, Talaut-islands north of Celebes, Kei Is., Aru Is., Jobi, New Guinea.

— Widely spread throughout Melanesia, Micronesia and Polynesia, as far eastward as Sandwich Is. and Paumotu. — Western Australia, Queensland, New South Wales, New Zealand. — Sulu Is., Philippines, Formosa, Loo-Choo, Japan, Hongkong, Cochin China, Pulo Kondor, Siam, Singapore, Pulu Penang, Mergui, Nicobars, Andaman Is., Ceylon and other islands of southern Asia, India, Persian Gulf, Aden, Red Sea, Gulf of Suez, Gulf of Akabah, East African coasts and islands, Natal, Port Elizabeth.

70. **Cypraea (Aricia) annulus** Linné.

1705 *Thoracium quartum*, slechte Cauris. Rumphius (100), p. 117, pl. XXXIX, fig. D.
1758 *Cypraea annulus*. Linné, Systema Naturae, edit. X, p. 723.
1764 — — Linné, Museum Ludovicae Ulricae, p. 578.
1767 — — Linné, Systema Naturae, edit. XII, p. 1179.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 402, nr. 61.
1825 — — Gray, Monogr. (28), vol. I, p. 494.
1834 — — Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, p. 45, pl. 48, figs. 14—16.

1837 *Cypraea annulus* L.. Sowerby, Conchological Illustrations, p. 6, pl. 20, figs. 115, 115.
1844 — — – Lamarck, An. s. vert. (53), vol. X, pp. 539—540, nr. 61.
1845 – — Kiener (32), vol. I, Cypraea, p. 124, pl. 34, fig. 2.
1845 — L.. Reeve (97), vol. III, Cypraea, species 71, pl. XV, fig. 71.
1850 — – Berge, Conchylienbuch (3a), p. 244, pl. 43, fig. 5.
1869 — *noumeensis*. Marie, Note sur quelques coquilles de la Nouvelle Calédonie (Journ. de Conchyliologie, vol. XVII), p. 18, pl. 2, fig. 6.
1869 — *annulus* L.. Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 40.
— — *noumeensis* Marie. Crosse, ibid., p. 40.
1870 — *annulus* L.. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 18, pl. XXVI, figs. 252, 253.
1871 — — – Lischke, Japan. Meeresconch. (59), vol. II, p. 65.
1874 — — Lischke, ibid., vol. III, p. 47.
1880 — — L.. Weinkauff, Cypraea (112), p. 69, pl. 20, figs. 9—12.
1884 – — – K. Martin, Tiefbohr. Java (72), p. 140.
1884 *Monetaria camelorum*. Rochebrune, Monographie des formes appartenant au genre Monetaria (Bulletin d. l. Soc. Malac. de France, vol. I), p. 86, pl. 1, fig. 7.
— — *annulus*. Rochebrune, ibid., p. 89, pl. 2, fig. 5.
— — *Harmandiana*. Rochebrune, ibid., p. 90, pl. 2, fig. 4.
— — *Noumeensis*. Rochebrune, ibid..
— – *Perrieri*. Rochebrune, ibid., p. 92, pl. 2, fig. 6.
1885 *Cypraea (Aricia) annulus* L.. Roberts in Tryon (109), vol. VII, p. 178, pl. 11, figs. 59—61.
1899 – — — – Melvill and Standen, Torres Straits (77), p. 164.
1899 — (*Aricia*) *annulus* L.. Horst et Schepman (31), p. 199.
1899 — *annulus* L.. Dautzenberg, Sumatra (15), p. 4.

1901 *Cypraea annulus* L.. H. Fischer, Djibouti, etc. (22*a*), p. 106.
1902 — — – von Martens, Rumphius Gedenkboek (71), p. 123.
1903 — *(Aricia) annulus* L. and monstr. *noumeensis* Marie. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 336—340.
1903 — *annulus* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 255, 276—277.
1906-'07 – *Annulus* L.. Hidalgo (30), pp. 136, 184, 257—260.
1907 — *annulus* L.. Couturier, Tahiti, etc. (13), p. 152.
1907 — — – Schepman, Posttertiär Celebes (102a), p. 183.
1909 — — – Schepman, Siboga exp. (104), p. 130.
1909 — — – Lamy, Java (56), p. 466.
1919 — — – K. Martin (75), pp. 90, 137.
1920 *(Aricia) annula* L.. Tesch, Timor (108), II, p. 46, pl. CXXIX, fig. 162.

Coral-island Pulu Pandjang, 12 specimens, all much worn.
Shore of Bali-strait, north of Banjuwangi, 1 specimen.
All the specimens agree in shape with the typical form.

Near reef of Batjulmati, East coast (Siboga expedition).
Enkhuizen-island near Batavia (Museum Amsterdam).
Tjilatjap (Leyden Museum).
Palabuan, Wijnkoopsbay (von Martens).

Distribution: Widely spread throughout the Malay Archipelago, especially on reefs: Sumatra (Benkulen; between Padang and Indrapura; Olehleh, Achin (Museum Wageningen)), Banka, Billiton, Borneo and Celebes and adjacent isles, Lombok, Sumbawa, Paternoster-islands, Flores, Timor, Luciparaisland, Amboina, Ceram, Sula Is., Bachan, East coast of Halmahera (Museum Wageningen), Kei Is., Aru Is., New Guinea.

Cypr. annulus occurs throughout the whole Indo-Pacific Sub-region and beyond it in Victoria (Australia) and New Zealand.

Fossil in the Miocene of Ngembak, Java, in neogene deposits of Timor (Lower Pliocene or Upper Miocene) and in the Pleistocene of Northern Celebes (Minahassa).

71. **Cypraea (Luponia) lynx** Linné.

1705 *Porcellana lentiginosa*. Rumphius (100), p. 115, pl. XXXVIII, fig. N.
1758 *Cypraea lynx*. Linné, Systema Naturae, edit. X, p. 721.
— — *Vanelli*. Linné, ibid., p. 720.
1764 — *lynx*. Linné, Museum Ludovicae Ulricae, p. 573.
— — *Vanelli*. Linné, ibid., p. 569, nr. 186.
1767 — *lynx*. Linné, Systema Naturae, edit. XII, p. 1176.
— — *Vanelli*. Linné, ibid., p. 1175, nr. 336.
1791 — *Venelli*. Gmelin, Syst. Nat. (27), p. 3402, nr. 12.
— — *Lynx*. Gmelin, ibid., p. 3409, nr. 48.
— — *squalina*. Gmelin, ibid., p. 3420, nr. 101.
1822 — *lynx*. Lamarck, An. s. vert. (52), vol. VII, pp. 388—389, nr. 29.
1824 — — Gray, Monogr. (28), vol. I, p. 151.
1836 — — L.. Sowerby, Conchological Illustrations, p. 2, figs. 107, 107.
1844 — — – Lamarck, An. s. vert. (53), vol. X, pp. 513—514.
1845 — — Kiener (32), vol. I, Cypraea, p. 10, pl. 25, fig. 2; pl. 38, fig. 2.
1845 — — L.. Reeve (97), vol. III, Cypraea, species 33, pl. IX, fig. 33.
1850 — — – Berge, Conchylienbuch (3a), p. 246.
1866 — — – Mabille et Le Mèsle, Observations sur la faune malac. de la Cochinchine et du Cambodge (Journ. de Conchyl., vol. XIV), p. 120.
1869 — — – Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conchyliologie, vol. XVII), p. 41.
1869 — *caledonica*. Crosse, ibid., p. 41, pl. 1, fig. 1.
1869 — *lynx* L.. Lischke, Japan. Meeresconch. (59), vol. I, p. 70.
1870 — — – Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 21, pl. XV, figs. 85*, 86*, 87*, 88*.
1871 — — Lischke, Japan. Meeresconch. (59), vol. II, p. 66.
1874 — — Lischke, ibid., vol. III, p. 47.
1880 — — L.. Weinkauff, Cypraea (112), pp. 79—80, pl. 23, figs. 6, 7.
1881 — *Caledonica* Crosse. Weinkauff, ibid., pp. 84—85, pl. 24, figs. 6, 7.

1885 *Cypraea (Luponia) lynx* L.. Roberts in Tryon (109), vol. VII, p. 183, pl. 14, figs. 86, 87, 98.
1888 — *lynx*, var. *Williamsi*. Melvill in: Memoirs and Proceedings of the Manchester Literary and Philosophical Society, p. 203.
1889 — — L.. L. Morlet, Catalogue des coquilles rec. par M. Pavie dans le Cambodge et le royaume de Siam (Journ. de Conchyliologie, vol. XXXVII), p. 141.
1891 — — — P. Fischer, Indo-Chine (22), p. 155 (reprint, p. 71).
1897 — — — von Martens (69), p. 290.
1899 — *(Luponia) lynx* L.. Melvill and Standen, Torres Straits (77), p. 164.
1899 — — — — Horst et Schepman (31), pp. 200—201.
1902 — *lynx* L.. von Martens, Rumphius Gedenkboek (71), p. 123.
1903 — *(Luponia) lynx* L. and var. *Williamsi* Melvill and monstr. *caledonica* Crosse. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 344—347.
1903 — *lynx* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 255, 276—277.
1906 — *(Luponia) lynx* L.. Dautzenberg et H. Fischer (18), pp. 401—402.
1906-'07 *Cypraea Lynx* L.. Hidalgo (30), pp. 139, 207, 408—410.
1907 — *lynx* L.. Couturier, Tahiti, etc. (13), p. 150.
1907 - *lynx* L.. Schepman, Posttertiär Celebes (102a), pp. 183—184.
1909 — *(Luponia) lynx* L.. Schepman, Siboga exp. (104), pp. 131, 231.
1909 — *lynx* L.. Lamy, Java (56), p. 466.
1920 - *(Luponia) lynx* L.. Tesch, Timor (108), II, p. 46, pl. CXXIX, fig. 161.

Coral-island Pulu Pandjang, 1 worn specimen.
Shore of Bali-strait, north of Banjuwangi, 1 worn specimen.
The specimens agree in shape with the typical form.
Tjilatjap (Leyden Museum).

Distribution: Padang (Sumatra), Banka, Billiton, Borneo, Northern Celebes, Sunda-strait, Lombok, Sumbawa, Flores,

Adonara, Timor, Lucipara-island, Amboina, Nusa-Laut-island, Sula Is., Talaut Is. (N. E. of Celebes), East coast of Halmahera (Museum Wageningen), Jobi and Waigeu near New Guinea, Kei Is., Aru Is.. Especially on reefs!

This species occupies the whole Indo-Pacific Sub-region from Capeland to Japan, Hawaii, the Marquesas and Paumotu, besides it occurs in New Zealand.

Fossil in the Pleistocene of Northern Celebes (Minahassa) and in the island of Timor in deposits, belonging to the Upper Pliocene or to the Lower Pleistocene.

72. **Cypraea (Luponia) errones** Linné.

1758 *Cypraea errones*. Linné, Systema Naturae, edit. X, p. 723, nr. 311.
1764 — — Linné, Museum Ludovicae Ulricae, p.577, nr. 202.
1767 — — Linné, Systema Naturae, edit. XII, p. 1178, nr. 352.
1780 — *spurca* (*not* of Linné). Born, Testacea musei caes. Vindobonensis, p. 190, pl. 8, fig. 14.
1791 — *erronea*. Gmelin, Syst. Nat., edit. XIII (27), p. 3411, nr. 57.
— — *Ovum*. Gmelin, ibid., p. 3412, nr. 65.
— — *oblonga*. Gmelin, ibid., p. 3416, nr. 88.
— — *cruenta*. Gmelin, ibid., p. 3420, nr. 103.
1795 *succincta* (*not* of Linné). Chemnitz, Conchylien-Cabinet, vol. XI, p. 38, pl. 180, figs. 1741, 1742.
1822 — *olivacea*. Lamarck, An. s. vert. (52), vol. VII, p. 392, nr. 37.
1824 — *errones*. Gray, Monogr. (28), vol. I, p. 385.
1825 — *subflava* (*not* of Gmelin). Wood, Index Testaceologicus, pl. 17, fig. 32.
1834 — *olivacea*. Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, pp. 42—43, pl. 48, fig. 13.
1837 — *errones* L.. Sowerby, Conchological Illustrations, p. 9, figs. 124, 128.
1844 — *olivacea*. Lamarck, An. s. vert. (53), vol. X, pp. 520—521.
1845 — *ovum*. Kiener (32), vol. I, Cypraea, p. 56, pl. 29, fig. 4.

1845 *Cypraea errones* L.. Reeve (97), vol. III, Cypraea, species 56, pl. XIII, fig. 56.
1855 — — Hanley, Ipsa Linnaei Conchylia, p. 191.
1869 — — L.. Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conch., vol. XVII), p. 46.
1870 — — — Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 21, pl. XX, figs. 156—158.
1874 — — — Lischke, Japan. Meeresconch. (59), vol. III, p. 48.
1877 — *Sophiae*. Brazier in: Proceedings Linnean Society New South Wales (Sydney), vol. I, p. 7.
1880 — *errones* L.. Weinkauff, Cypraea (112), p. 20, pl. 4, figs. 10—11.
1885 — *(Luponia) errones* L.. Roberts in Tryon (109), vol. VII, pp. 183—184, pl. 14, figs. 7, 88, 89.
— — — *Sophiae* (*not* of Brazier). Roberts in Tryon, ibid., p. 184, pl. 14, figs. 3, 4.
1895 — *errones* Linné. Schepman, Borneo (102), p. 162.
1899 — *(Luponia) errones* L.. Melvill and Standen, Torres Straits (77), p. 164.
1899 — — — — Horst et Schepman (31), p. 201.
1902 — *erronea* L.. von Martens, Rumphius Gedenkboek (71), p. 123.
1903 — *(Luponia) errones* L.. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 347—349.
1906-'07 — *errones* L.. Hidalgo (30), pp. 138, 197, 340—343.
1909 — *(Luponia) errones* L. and var. *ovum* Gmel.. Schepman, Siboga exp. (104), p. 132.
1909 — *errones* L.. Lamy, Java (56), p. 466.
1911 — *(Luponia) errones* L.. H. Martin-Icke, Trinil (76), p. 47.

Coral-island Pulu Pandjang, 2 worn specimens, one belonging to the form *ovum* Gmelin.

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Padang (Sumatra), Banka, Billiton, Borneo, Celebes, Saleyer, Lombok, Flores,

Savu, Timor, Lucipara-island, Amboina, Nusa-Laut-island, Kei Is., Aru Is., New Guinea.
— Melanesia; Micronesia; Polynesia to Hawaii and Paumotu; Torres Straits, Queensland, New South Wales.
— Sulu-archipelago, Philippines, Loo-Choo, Japan, China, Siam, Singapore, Andaman Is:, Madras, Ceylon, Chagos, Mauritius, Madagascar, Red Sea.

Fossil in the Pliocene of Sondé (Resid. Madiun), Java.

73. **Cypraea (Luponia) miliaris** Gmelin.

1791 *Cypraea miliaris*. Gmelin, Syst. Nat., edit. XIII (27), p. 3420, nr. 106.
1832 — *Lamarcki* (*not* of Gray) var.. Sowerby, Conchological Illustrations, p. 6, fig. 12*.
1845 — *Lamarckii* (*not* of Gray). Kiener (32), vol. I, Cypraea, p. 59, pl. 8, fig. 2.
1845 — *miliaris* Gmel.. Reeve (97), vol. III, Cypraea, species 36, pl. X, fig. 36.
1869 — — — Lischke, Japan. Meeresconch. (59), vol. I, p. 71.
1870 — — — Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 36, pl. XVII, fig. 109.
1871 — — — Lischke, Japan. Meeresconch. (59), vol. II, p. 167.
1874 — — — Lischke, ibid., vol. III, p. 48.
1881 — — — Weinkauff, Cypraea (112), p. 110, pl. 33, figs. 9, 12.
1885 — *(Luponia) miliaris* Gmel.. Roberts in Tryon (109), vol. VII, p. 192, pl. 17, fig. 80.
1899 — *(Ocellaria) miliaris* Gmel.. Horst et Schepman (31), p. 204.
1903 — *(Luponia) Lamarcki* Gray, var. *miliaris* Gmel.. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 363—364.
1906-'07 *Cypraea miliaris* Gmel.. Hidalgo (30), pp. 210, 428.
1909 *Cypraea (Luponia) miliaris* Gmel.. Schepman (104), p. 134.
Not *Cypraea miliaris* of Lamarck (Annales du Muséum, XVI and An. s. vertèbres).

Coast near Government Rubber Estate Balong, N. E. of Japara (Resid. Semarang), 1 worn specimen.

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Billiton, Sumbawa, Amboina, Moluccas, West coast of New Guinea. — Torres Straits, New South Wales, New Caledonia. — Philippines, Formosa, Loo-Choo, Japan, Amoy (China), Siam. — Madagascar, Mozambique, Natal, Capeland.

74. **Cypraea (Luponia) erosa** Linné.

1705 *Thoracium oculatum*. Rumphius (100), p. 117, pl. XXXIX, fig. A.
1758 *Cypraea erosa*. Linné, Systema Naturae, edit. X, p. 723.
1764 — — Linné, Museum Ludovicae Ulricae, p. 579.
1767 — — Linné, Systema Naturae, edit. XII, p. 1179.
1791 — *ferruginosa*. Gmelin, Syst. Nat., edit. XIII (27), p. 3403, nr. 19.
— — *erosa*. Gmelin, ibid., pp. 3415—3416, nr. 84.
— — *similis*. Gmelin, ibid., p. 3421, nr. 111.
1811 — *stellata*. Perry, Conchology, pl. 22, fig. 2.
— — *fasciata*. Perry, ibid., pl. 22, fig. 9.
1822 — *erosa*. Lamarck, An. s. vert. (52), vol. VII, p. 389, nr. 31.
1834 — — Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, pp. 31—32, pl. 47, figs. 12, 13.
1837 — — L.. Sowerby, Conchological Illustrations, p. 6, figs. 119, 119.
1844 — — L.. Deshayes in Lamarck, An. s. vert. (53), vol. X, pp. 515—516 (exclusive of syn. *C. miliaris* Gmel.).
1845 — — – Kiener (32), vol. I, Cypraea, p. 53, pl. 9, figs. 2, 3.
1845 — — – Reeve (97), vol. III, Cypraea, species 43, pl. XI, fig. 43.
1866 — — – Mabille et Le Mesle, Observations sur la faune malac. de la Cochinchine et du Cambodge (Journ. de Conchyl., vol. XIV), p. 120.
1869 — — – Crosse, Catalogue des Cypraea de la Nouvelle Calédonie (Journ. de Conchyl., vol. XVII), p. 45.
1869 — — – Lischke, Japan. Meeresconch. (59), vol. I, p. 72.

1870 *Cypraea erosa* L.. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 37, pl. XVIII, figs. 110—115.
1871 — — – Lischke, Japan. Meeresconch. (59), vol. II, p. 66.
1874 — — Lischke, ibid., vol. III, p. 47.
1879 — — Linn.. Woodward, Fossil shells from Sumatra (114*a*), p. 498, pl. XIII, figs. 10 a, b.
1881 — L.. Weinkauff, Cypraea (112), p. 107, pl. 33, figs. 1—4.
1885 *(Luponia) erosa* L.. Roberts in Tryon (109), vol. VII, p. 192, pl. 18, figs. 90, 100, 1.
1889 *erosa* L.. L. Morlet, Catalogue des coquilles rec. par M. Pavie dans le Cambodge et le royaume de Siam (Journ. de Conchyl., vol. XXXVII), p. 140.
1891 — — – P. Fischer, Indo-Chine (22), p. 157 (reprint, p. 73).
1895 — — – Schepman, Borneo (102), p. 162.
1899 *(Ocellaria) erosa* L.. Horst et Schepman (31), p. 205.
1899 — — — – K. Martin, Foss. v. Java (73), pp. 174—175, pl. XXVIII, fig. 406.
1902 *erosa* L.. von Martens, Rumphius Gedenkboek (71), p. 123.
1903 *(Luponia) erosa* L.. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 366—367.
1903 *erosa* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 255, 276—277.
1906 *(Luponia) erosa* L.. Dautzenberg et H. Fischer (18), pp. 399—400.
1906-'07 – *erosa* L.. Hidalgo (30), pp. 138, 196, 336—339.
1907 — — – Couturier, Tahiti, etc. (13), p. 150.
1907 — — – Schepman, Posttertiär Celebes (102a), p. 185.
1909 *(Luponia) erosa* L.. Schepman, Siboga exp. (104), p. 134.
1909 *erosa* L.. Lamy, Java (56), p. 466.
1911 *(Ocellaria) erosa* L.. H. Martin–Icke, Trinil (76), p. 47.
1911 *erosa* L.. K. Martin, Vorläuf. Bericht (74), p. 46.

1919 *Cypraea erosa* L.. K. Martin (75), pp. 90, 127, 128, 141.
1920 — *(Ocellaria) erosa* L.. Tesch, Timor (108), II, p. 47, pl. CXXIX, fig. 163.
1920 — *(Erosaria) erosa* Linn.. Vredenburg, Cypraeidae (110*a*), p. 113.

Tji Solok, Wijnkoopsbay, 2 specimens, resembling figs. 2—3 of Weinkauff (var. *chlorizans* Melvill; var. 2 of Hidalgo).

Near Palabuan, Wijnkoopsbay (von Martens).

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Sumatra, Banka, Borneo, Saleyer (S. of Celebes), Talaut Is. (N. E. of Celebes), Sumbawa, Postillon-islands, Timor, Amboina, Nusa-Laut-island, Bachan, Jobi-island near New Guinea, Kei Is., Aru Is..

— Distributed throughout the whole Indo-Pacific Sub-region, besides in New Zealand, Capeland and perhaps also in the South Atlantic (Ascension-island, Annobon and Cape Verde).

Fossil in the Lower and Upper Miocene and in the Pliocene of Java, in the Miocene of the island of Nias near Sumatra, in pliocene deposits in the isle of Timor and in the Pleistocene of Northern Celebes (Minahassa). Also in the Pleistocene of Obock (Somaliland, E. Africa).

75. **Cypraea (Luponia) gangrenosa** (Solander) Dillwyn.

1817 *Cypraea gangraenosa* Solander. Dillwyn, A descriptive Catalogue of recent shells, vol. I, p. 465.
1832 — *gangrenosa* Sol.. Sowerby, Conchological Illustrations, p. 5, figs. 8, 8, 8*.
1844 *gangrenosa* Dilw.. Deshayes in Lamarck, An. s. vert. (53), vol. X, pp. 561—562, nr. 90.
1845 — — Kiener (32), vol. I, Cypraea, p. 50, pl. 50, fig. 2.
1846 *flaveola* (*not* of Linné). Reeve (97), vol. III, Cypraea, species 95, pl. XVIII, fig. 95.
— — *gangrenosa*. Reeve, ibid., spec. 96, pl. XVIII, figs. 96 a, b.
1852 — *Reentsii*. Dunker in: Zeitschrift für Malakozoologie, 1852, p. 189.

1869 *Cypraea Helenae*. Roberts, Descriptions of two new species of Cypraea (American Journal of Conchology, vol. IV), p. 250, pl. 15, figs. 7—10.
1870 — *gangraenosa* Soland.. Sowerby, Thesaurus (106), vol. IV, Cypraea, p. 38, pl. XXV, figs. 230—235; pl. XXXVII, fig. 531.
1881 — *gangrenosa* (Soland.) Dillw.. Weinkauff, Cypraea (112), pp. 121—122, pl. 36, figs. 2, 3.
1885 — *(Luponia) gangranosa* Soland.. Roberts in Tryon (109), vol. VII, pp. 195–196 (excl. of var. *Boivini*), pl.19, figs. 18, 19, 27, 28.
— — — *flaveola* (*not* of Linné). Roberts, ibid., p. 195, pl. 19, figs. 20, 21, 22.
1899 — *(Ocellaria) gangrenosa* Soland. and var. *flaveola* Rve.. Horst et Schepman (31), p. 206.
1903 — *(Luponia) gangrenosa* (Solander) Dillwyn. Dautzenberg, Revis. Cypr. Nouv. Caléd. (16), pp. 371—372.
1906-'07 — *gangrenosa* Solander. Hidalgo (30), pp. 138, 200, 363—366.
1907 — — Sol., var. *flaveola* Rve. (non Lin.). Schepman, Posttertiär Celebes (102a), p. 185.
1909 — *(Luponia) gangrenosa* Soland.. Schepman, Siboga exp. (104), p. 136.
— — — *flaveola* (*not* of Linné). Schepman, ibid., p. 135.

Tji Solok, Wijnkoopsbay, 1 specimen belonging to the typical form (like fig. 96a of Reeve).

Tjilatjap (Leyden Museum).

Distribution: Eastern part of the Malay Archipelago: Lombok, Sumbawa, Postillon-islands, Flores, Rotti, Timor, Ceram, Watubela Is. (S. E. of Ceram).

— Torres Straits, Queensland, New South Wales, New Caledonia and Loyalty Is.. — Sulu-archipelago, Philippines, Japan, China. — Andaman Is., Ceylon, Laccadive Is., Maldive Is., Aden, Zanzibar, Mauritius, Mozambique.

Fossil in the Pleistocene of Northern Celebes (Minahassa).

FAM. **CASSIDIDAE.**

Genus **Cassis** (Rumphius, 1705) Martini, 1773.

76. **Cassis cornuta** Linné sp..

1705 *Cassis tuberosa prima sive cornuta.* Rumphius (100), pl. XXIII, figs. A, 1.
1758 *Buccinum cornutum.* Linné, Systema Naturae, edit. X, p. 735.
1767 — — Linné, Syst. Nat., edit. XII, p. 1198.
1822 *Cassis cornuta.* Lamarck, An. s. vert. (52), vol. VII, pp. 219—220, nr. 2.
1844 — — Lamarck, An. s. vert. (53), vol. X, pp. 20—21.
1848 — — Reeve (97), vol. V, Cassis, pl. I, fig. 2.
1857 — — Küster (43), p. 11, pl. 38, fig. 3; pl. 40; pl. 41.
1869 — — Lischke, Japan. Meeresconch. (59), vol. I, p. 62.
1885 — — Tryon (109), vol. VII, p. 270, pl. 2, fig. 49; pl. 1, figs. 45, 46.
1894 — — Horst et Schepman (31), p. 176.
1902 — — von Martens, Rumphius Gedenkboek (71), pp. 115, 116.
1919 — — K. Martin (75), p. 88.

Coral-island Pulu Pandjang.

The only specimen has a height of 21½ cm., maximum diameter 17½ cm., length of outer lip 22½ cm.. It is rather worn and covered with tubes of *Serpula*.

Distribution: East Indian Archipelago: Billiton, Borneo, Timor, Amboina, Moluccas, New Guinea. — Philippines, Nagasaki (Southern Japan). — Pacific Islands. — Tranquebar (Coromandel Coast). — Mauritius, Réunion, Madagascar.

According to Tryon the species occurs also in the West Indies.

Fossil in the Upper Miocene of Java.

77. **Cassis** (**Bezoardica**) **decussata** Linné sp..

1758 *Buccinum decussatum.* Linné, Syst. Naturae, edit. X, p. 736.

1767 *Buccinum decussatum*. Linné, Syst. Nat., edit. XII, p. 1199.
1822 *Cassis decussata*. Lamarck, An. s. vert. (52), vol. VII, p. 223, nr. 11 (in part).
1844 — — Deshayes in Lamarck, An. s. vert. (53), vol. X, pp. 29—30.
1848 — — Reeve (97), vol. V, Cassis, pl. II, figs. 4 a, b, c, d.
1885 *Cassis (Bezoardica) decussata* Lam.. Tryon (109), vol. VII, p. 277, pl. 7, figs. 87, 88.
1899 — — — Linné. Horst et Schepman (31), p. 180.

Surabaya, Harbour, mud, 1 bleached specimen.
Tjilatjap (Leyden Museum).
Distribution: Timor (Leyden Museum).
Tryon did not yet know the habitat of this species.

FAM. **DOLIIDAE.**

78. **Pirula reticulata** Lamarck.

1822 *Pyrula reticulata*. Lamarck, An. s. vert. (52), vol. VII, p. 141, nr. 9.
— — *ficoides*. Lamarck, ibid., p. 142, nr. 11.
1840 *Pyrula reticulata*. Kiener (32), vol. VI, Pyrula, p. 28, pl. 12, fig. 1.
— — *ficoides*. Kiener, ibid., p. 29, pl. 13, fig. 2.
1843 *Pyrula reticulata*. Lamarck, An. s. vert., 2e édit. (53), vol. IX, p. 510.
— — *ficoides*. Lamarck, ibid., pp. 511—512.
1847 *Ficula reticulata*. Reeve (97), vol. IV, Ficula, pl. I, fig. 1.
1869 — — Lischke, Japan. Meeresconch. (59), vol. I, p. 40.
1871 — — Lischke, ibid., vol. II, p. 28.
1874 — — Kobelt, Pyrula u. Fusus (39), p. 7, pl. 1, figs. 4, 5; pl. 19, figs. 5, 6.
1885 *Pyrula reticulata* Lam.. Tryon (109), vol. VII, p. 265, pl. 5, fig. 28.
1899 *Pirula reticulata* and var. *ficoides*. Horst et Schepman (31), p. 187.
1902 — *ficoides* Lam.. von Martens, Rumphius Gedenkboek (71), p. 117.

1909 *Pirula reticulata* Lk.. Lamy, Java (56), p. 466.
1919 — *ficoides* Lamk.. K. Martin (75), p. 89.

Surabaya, Harbour, mud, 1 specimen, damaged and bleached.

Distribution: East Indian Archipelago: West coast of Borneo, Southern Celebes, Flores, Amboina.
— Sulu Sea N. of Borneo, Hongkong, Southern Japan. — Coromandel Coast, Ceylon, Zanzibar, Coast of Mozambique.

Fossil in the Miocene of Java.

FAM. **TRITONIDAE.**

79. **Cymatium pyrum** Linné sp..

1705 Gedroogde peer. Rumphius (100), pl. XXVI, fig. E.
1758 *Murex pyrum*. Linné, Systema Naturae, edit. X, p. 749.
1767 — — Linné, Syst. Nat., edit. XII, p. 1218.
1822 *Triton pyrum*. Lamarck, An. s. vert. (52), vol. VII, p. 183, nr. 12.
1842 *Triton pirum* Lam.. Kiener (32), vol. VII, Triton, p. 7, pl. 11, fig. 1 (*pyrum* on the plate).
1843 *Triton pyrum*. Lamarck, An. s. vert. (53), vol. IX, p. 633, nr. 12.
1844 — — Reeve (97), vol. II, Triton, pl. X, fig. 33.
1881 *Triton (Cymatium) pyrum*. Tryon (109), vol. III, p. 19, pl. 10, fig. 74.
1894 *Triton (Ranularia) pyrum*. Horst et Schepman (31), p. 169.
1902 *Tritonium pyrum*. von Martens, Rumphius Gedenkboek (71), p. 116.

Java (without exact locality), 1 specimen.

Distribution: West coast of Borneo. Timor. Amboina, Bachan.
— Philippines. — Indian Ocean.

FAM. **PYRAMIDELLIDAE.**

80. **Actaeopyramis sp..**

The only specimen of *Actaeopyramis* is not adult and probably bleached (the colour is bluish grey); the interior of the aperture is not specially coloured. It may belong to *A. striata*

Gray [1]), of which it has the general appearance and grooves, but I am not quite certain.

Coast near mouth of river Tji Lamaja, 1 specimen.

FAM. **COLUMBELLIDAE.**

81. **Columbella (Anachis) terpsichore** (Leathes M.S.) Sowerby.

1822	*Columbella*			*Terpsichore* (Leathes M. S.). Sowerby, Genera (105), Columbella, fig. 6.
1841	—			*lineolata*. Kiener (32), vol. IX, Columbella, p. 57, pl. 13, fig. 3.
1844	—			*Terpsichore*, Leathes. Sowerby, Thesaurus (106), vol. I, p. 126 (bis), pl. XXXVIII, figs. 98, 99.
1844	—			*terpsichore* Sowerby. Deshayes in Lamarck, An. s. vert. (53), vol. X, pp. 285—286.
1858	—			*Terpsichore* Sow.. Reeve (97), vol. XI, Columbella, spec. 59, pl. XII, fig. 58 b.
1883	*Columbella*	*(Anachis)*		*Terpsichore*. Tryon (109), vol. V, p. 154, pl. 54, figs. 44, 45.
1887	—	—	—	von Martens, Mergui (67), p. 183.
1892	—	—	*terpsichore*.	Kobelt, Columbelliden (38), p. 60, pl. 8, figs. 5, 6.
1894	—	—	—	and var. *lineolata* Kiener. Horst et Schepman (31), p. 129.
1911	—	—	*Terpsichore*	Sow. var. *lineolata* Kiener. Schepman (104), p. 336.

Tji Solok, Wijnkoopsbay, 1 specimen.
Tjilatjap (Leyden Museum).

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[1]) 1855 *Monoptygma striata* Gray. A. Adams in Sowerby, Thesaurus (106), vol. II, p. 816, pl. 172, fig. 18.
1885 *Pyramidella* (*Actaeopyramis*) *striata* Gray. P. Fischer, Manuel (21), p. 787.
1886 — — — — Tryon (109), vol. VIII, p. 313, pl. 74, fig. 39.

Distribution: East Indian Archipelago: Sumatra, Timor, Amboina.
— Mergui-archipelago (Tenasserim), Ceylon. — Japan.

This species was originally described from Nevis in the West-Indies. I don't know whether it really occurs there. My specimen from Tji Solok agrees quite well with Sowerby's description and figures in the Thesaurus.

As has been pointed out by H. Fischer (23) the shell from the Red Sea described and figured as *Columbella terpsichore* by R. Sturany [1]) does not belong to Sowerby's species, but to *Columbella fauroti* Jousseaume sp..

FAM. **MURICIDAE.**

82. **Murex (Tribulus) martinianus** Reeve.

1845 *Murex Martinianus*. Reeve (97), vol. III, Murex, spec. 72, pl. XVIII, fig. 72.
1868 — — Kobelt in Conch.-Cab. (48), p. 59, pl. 9, fig. 3; pl. 122, figs. 7, 8.
1880 *Murex rarispina*. Sowerby, Thesaurus (106), vol. IV, Murex, p. 3, pl. I, fig. 2.
1880 *Murex (Tribulus) ternispina*, pars. Tryon (109), vol. II, p. 78, pl. 11, fig. 118.
1894 *Murex (s. str.) martinianus*. Horst et Schepman (31), p. 135.
1902 *Murex Martinianus* Reeve. von Martens, Rumphius Gedenkboek (71), p. 116.
1911 *Murex (Tribulus) martinianus*. Schepman (104), p. 343.

Coast near mouth of river Tji Lamaja, 5 specimens.
Coast near Government Rubber Estate Balong, N. E. of Japara, Resid. Semarang, 1 specimen.
Surabaya, 4 specimens.
Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Mentawei-islands near Sumatra, Banka, Borneo-bank (Strait of Makassar), Southern Celebes, Saleyer, Lombok, Obi.
— Amoy (China). — Madagascar.

1) Gastropoden des Rothen Meeres; Expeditionen S. M. Schiff „Pola" in das Rothe Meer, XXIII (107*a*), pp. 248, 274—275, pl. V, figs. 4 a—b.

83. **Murex (Chicoreus) torrefactus** Sowerby.

1840 *Murex torrefactus*. Sowerby in: Proceedings Zoological Society, 1840.
1845 — — Reeve (97), vol. III, Murex, species 41, pl. X, fig. 41.
1880 — — Sowerby, Thesaurus (106), vol. IV, Murex, p. 15, pl. V, fig. 47.
1880 *Murex (Chicoreus) torrefactus*. Tryon (109), vol. II, p. 89, pl. 14, fig. 145.
1894 — — — Horst et Schepman (31), p. 138.
1907 — — — Couturier, Tahiti, etc. (13), p. 142.

Tji Solok, Wijnkoopsbay, 1 damaged specimen.
Tjilatjap (Leyden Museum).
Distribution: East Indian Archipelago: Flores, Amboina. — China. — Paumotu. — Mauritius, Madagascar.

84. **Purpura persica** Linné sp..

1758 *Buccinum persicum*. Linné, Systema Naturae, edit. X, p. 738.
1767 — — Linné, Syst. Nat., edit. XII, p. 1202.
1822 *Purpura persica*. Lamarck, An. s. vert. (52), vol. VII, p. 235, nr. 1.
1835-'36 — — Kiener (32), vol. VIII, Purpura, p. 93, pl. 25, fig. 67.
1844 — — Lamarck, An. s. vert. (53), vol. X, p. 59.
1846 — — Reeve (97), vol. III, Purpura, pl. II, fig. 8.
1859 — — Küster in Conch.-Cab. (42), p. 110, pl. 20, fig. 2.
1880 — — Tryon (109), vol. II, p. 160, pl. 43, figs. 23, 24.
1887 — — von Martens, Mergui (67), p. 178.
1894 *Purpura (s. str.) persica*. Horst et Schepman (31), p. 147.
1899 *Purpura persica*. Melvill and Standen, Torres Straits (77), p. 162.
1909 — — Lamy, Java (56), p. 465.

Java (without exact locality), 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: Torres Straits, Western Australia. — Marquesas Is.. — Philippines. — Mergui archipelago (Further India). — Mauritius, Réunion, Natal.

85. **Cuma javanica** Philippi sp..

Figure 13.

1836 *Purpura undata* var. (*not* of Lamarck). Kiener (32), vol. VIII, Purpura, pl. 35, figs. 84, 84.
1848 *Purpura javanica*. Philippi, Testac. nov. centuria (87), p. 27.
1859 — — Philippi. Küster in Conch.-Cab. (42), p. 171, pl. 28, figs. 10, 11.
1880 — — Phil.. Tryon (109), vol. II, p. 239, pl. 63, fig. 331.
1902 — *Javanica* Phil.. von Martens, Rumphius Gedenkboek (71), p. 116.
1905 *Cuma javanica* Philippi. Dautzenberg et H. Fischer. Tonkin (17), p. 122.
1909 *Purpura javanica* Phil.. Lamy, Java (56), p. 465.

Coast near Government Rubber Estate Balong, N. E. of Japara (Resid. Semarang), 1 young specimen (figure 13).
The species has been recorded from Java by Philippi and Lamy, but, as far as I know, this is the first exact locality.
Distribution: East Indian Archipelago: Mampawa (West coast of Borneo), Larantuka (Flores).
— Tongking (Along Bay), on rocks; numerous specimens collected at low tide (17).

FAM. **NASSIDAE.**

86. **Nassa (Hima) stolata** Gmelin sp..

Figure 14.

1791 *Buccinum stolatum*. Gmelin, Syst. Nat. (27), p. 3496, nr. 121.
1834 *Buccinum ornatum*. Kiener (32), vol. IX, Buccinum, p. 80, nr. 79, pl. 21, fig. 83.

1844 *Buccinum stolatum* Gmel.. Deshayes in Lamarck, An. s. vert. (53), vol. X, pp. 199—200.
1853 *Nassa ornata* Kiener. Reeve (97), vol. VIII, Nassa, spec. 33, pl. V, fig. 33.
1882 *Nassa (Hima) stolata*. Tryon (109), vol. IV, p. 45, pl. 14, fig. 225.
1887 *Nassa stolata*. von Martens, Mergui (67), p. 180.
1894 *Nassa (Hima) stolata*. Horst et Schepman (31), p. 119.
1895 — — — K. Martin, Foss. v. Java (73), p. 116, pl. XVIII, figs. 262, 262 a.
1909 *Nassa stolata*. Lamy, Java (56), p. 465.
1919 — — K. Martin (75), pp. 84, 146.

Coast near mouth of river Tji Lamaja, 3 specimens (figure 14).
Surabaya, shore of Bandjaran, 1 bleached specimen.
Surabaya (without particular locality), 4 specimens.
Distribution: Borneo.
— Singapore, Mergui-archipelago, Ceylon, Red Sea. — Japan.
Fossil in the upper quaternary deposits near Grissee, Java.

FAM. **BUCCINIDAE.**

87. **Tritonidea (Cantharus) tranquebarica** Gmelin sp..

1791 *Buccinum tranquebaricum*.. Gmelin, Syst. Nat. (27), p. 3491, nr. 86.
1822 — *tranquebaricum*. Lamarck, An. s. vert. (52), vol. VII, p. 268, nr. 15.
1825 — *Tranquebaricum*. Sowerby, Genera (105), Buccinum, fig. 6.
1834 — — Kiener (32), vol. IX, Buccinum, p. 36, nr. 37, pl. 23, fig. 92.
1844 — *tranquebaricum*. Deshayes in Lamarck, An. s. vert. (53), vol. X, p. 163.
1846 — *Tranquebaricum*. Reeve (97), vol. III, Buccinum, spec. 17, pl. III, fig. 17.
1881 *Cantharus Tranquebaricus*. Tryon (109), vol. III, p. 154, pl. 73, fig. 244.
1887 *Pollia tranquebarica*. von Martens, Mergui (67), p. 180.

1894 *Tritonidea (Cantharus) tranquebarica*. Horst et Schepman (31), p. 107.

Shore near Tjilatjap, 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: Ceram.
— Mergui-archipelago, Tranquebar (Coromandel Coast).

88. **Latrunculus canaliculatus** Schumacher sp..

1705 Schynvoet in Rumphius (100), pl. XLIX, fig. D.
1817 *Nassa canaliculata*. Schumacher, Essai d'un nouv. syst. (104*a*), p. 224.
1822 *Eburna spirata*. Lamarck (*non* Linné), An. s. vert. (52), vol. VII, pp. 281—282, nr. 3.
1835 — — Kiener (32), vol. IX, Eburna, p. 7, pl. 1, fig. 1.
1844 — — Lamarck (*non* Linné), An. s. vert. (53), vol. X, pp. 233—234.
1849 — — Lamarck (*not* of Linné). Reeve (97), vol. V, Eburna, pl. I, fig. 7.
1857 — — (*not* of Linné). Küster in Conch.-Cab. (43), pp. 80—82, pl. 65, fig. 3.
1860 *Eburna canaliculata* Schum.. Sowerby, Thesaurus (106), vol. III, p. 69, pl. 215, fig. 2.
1881 *Eburna spirata* Lam.. Tryon (109), vol. III, p. 212, pl. 82, figs. 466—468.
1887 *Eburna canaliculata*, Schumacher. von Martens, Mergui (67), p. 180.
1894 *Dipsaccus canaliculatus* Schumacher. Horst et Schepman (31), p. 110.
1895 *Dipsaccus canaliculatus* Schum.. K. Martin, Foss. v. Java (73), p. 101, pl. XVI, figs. 224—227.
1919 — — — K. Martin (75), pp. 83, 125, 128, 132.

Surabaya, Harbour, mud, 1 specimen.
Shore near Tjilatjap, 1 specimen.
Distribution: Philippines, Mergui-archipelago, Ceylon.
Fossil: Upper Miocene (Tjilanang-beds) and Pliocene of Java.

89. **Siphonalia (Pseudoneptunea) varicosa** Chemnitz sp..

Figures 15 a, b.

1789 *Murex varicosus*. Chemnitz, Conchylien-Cabinet, vol. X, p. 256, pl. 162, figs. 1546, 1547.
1840 *Fusus varicosus*. Kiener (32), vol. V, Fusus, p. 41, nr. 33, pl. 10, fig. 2.
1843 — — Kiener. Deshayes in Lamarck, An. s. vert. (53), vol. IX, p. 477.
1846 *Buccinum varicosum*. Reeve (97), vol. III, Buccinum, species 10, pl. II, fig. 10.
1880 *Fusus varicosus*. Kobelt, Pyrula u. Fusus (39), p. 144, pl. 46, figs. 4, 5.
1881 *Siphonalia varicosa* Kiener. Tryon (109), vol. III, p. 137, pl. 54, fig. 353.
1884 *Fusus (Neptunea) varicosus* Chemn.. K. Martin, Tiefbohr. Java (72), p. 101.
1919 *Siphonalia varicosa*. K. Martin (75), pp. 82, 124.

Surabaya, Harbour, mud, 2 specimens (figures 15 a, b).

Measurements of the larger specimen: Height: 42 mm., maximum diameter: 24 mm..

The greater shell has some obsolete teeth on the inner side of the outer lip. This character was already pointed out by Deshayes in his description of the species. The specimens are in an excellent condition, much better than those figured by Chemnitz and Kiener. They agree fairly well with Reeve's figure. The colour is however not dull brown as in Reeve's specimen, but pale grayish roseate as indicated by Kiener („d'un rosé pâle, quelquefois mêlé de grisâtre"). I think they may be somewhat bleached. Within the aperture my specimens are coloured roseate as in Reeve's figure.

Distribution: Reeve did not know the habitat of this species, Kobelt presumes it might be from the West-Indies, Tryon records „habitat unknown".

The specimens from Surabaya confirm the eastern habitat given by Kiener („habite les côtes de l'Océanie, celles de l'île Timor"). On the other hand the habitat Peru given by Deshayes is probably not correct.

Siphonalia varicosa is recorded as a fossil in quaternary

deposits at Batavia and with some restriction from the Pliocene of Timor (Tesch (108), I, p. 53, pl. LXXX, fig. 114).

FAM. **TURBINELLIDAE.**

90. **Melongena** (**Pugilina**) **pugilina** Born sp..

1780 *Murex pugilinus.* Ign. de Born, Testacea musei caes. Vindobonensis, quae jussu Mariae Theresiae Augustae disposuit et descripsit etc., p. 314.
1791 *Murex Vespertilio.* Gmelin, Syst. Nat. (27), p. 3553, nr. 100.
1822 *Pyrula vespertilio.* Lamarck, An. s. vert. (52), vol. VII, p. 140, nr. 7.
1840 — — Lam.. Kiener (32), vol. VI, Pyrula, p. 6, pl. 5, fig. 1.
1843 — — Lamarck, An. s. vert. (53), vol. IX, p. 508, nr. 7.
-- *Pyrula pugilina.* Deshayes in Lamarck, An. s. vert. (53), vol. IX, p. 508, note 1.
1847 — — Reeve (97), vol. IV, Pyrula, pl. I, fig. 1 b.
1875 — — Born sp.. Kobelt, Pyrula u. Fusus (39), p. 33, pl. 15, figs. 1, 2.
1880 — — Sowerby, Thesaurus (106), vol. IV, p. 101, Pyrula, pl. II, figs. 11, 12.
1881 *Melongena pugilina.* Tryon (109), vol. III, p. 110, pl. 43, figs. 220, 222.
1884 *Fusus (Pugilina) vespertilio* Lam.. K. Martin, Tiefbohr. Java (72), p. 99.
1887 *Hemifusus (Pugilina) pugilinus.* von Martens, Mergui (67), p. 180.
1894 *Melongena (Pugilina) pugilina.* Horst et Schepman (31), p. 97.
1909 *Melongena pugilina.* Lamy, Java (56), p. 465.
1912 *Pyrula (Melongena) pugilina* Born. K. Martin, Vorläuf. Bericht (74), p. 164.
1919 *Melongena pugilina* Born. K. Martin (75), pp. 82, 133, 146.

Surabaya, Harbour, mud, 2 specimens.
Surabaya, shore of Bandjaran, 1 specimen.
North coast of Resid. Besuki (Leyden Museum). Tjilatjap (Leyden Mus.).
Distribution: Sumatra, Borneo.

— Philippines, Cochin China, Singapore, Mergui-archipelago (on a sand-flat), Coromandel Coast, Ceylon.

Fossil in the Pliocene and Pleistocene of Java.

91. **Semifusus ternatanus** Gmelin sp..

1791 *Murex ternatanus*. Gmelin, Syst. Nat. (27), p. 3554, nr. 107.
1822 *Pyrula ternatana*. Lamarck, An. s. vert. (52), vol. VII, p. 143, nr. 15.
1840 *Fusus ternatanus* Martini. Kiener (32), vol. V, Fusus, p. 52, nr. 43, pl. 27.
1843 *Pyrula ternatana*. Lamarck, An. s. vert. (53), vol. IX, pp. 513—514.
1847 — *Ternatana*. Reeve (97), vol. IV, Pyrula, pl. II, fig. 6.
1875 — *ternatana* Gmelin sp.. Kobelt, Pyrula u. Fusus (39), p. 42, pl. 5, figs. 4, 5; pl. 33, figs. 1, 2.
1880 — — — Sowerby, Thesaurus (106), vol. IV, p. 102, Pyrula, pl. I, fig. 7.
1881 *Hemifusus ternatanus* Gmel.. Tryon (109), vol. III, p. 112, pl. 44, fig. 233.
1884 *Fusus ternatanus* Martini. K. Martin, Tiefbohr. Java (72), pp. 99—100.
1885 *Pyrula ternatana*. Boog Watson, Challenger Gasterop. (8), p. 212.
1887 *Hemifusus Ternatanus*. von Martens, Mergui (67), p. 180.
1894 *Semifusus ternatanus* Gmel.. Horst et Schepman (31), p. 99.
1907 — — — Schepman, Celebes (102a), p. 172.
1919 — — — K. Martin (75), pp. 82, 124, 146.

Surabaya, Harbour, mud, 2 specimens.

Distribution: Ternate, Moluccas.

— Philippines (on mud banks), Singapore, Mergui-archipelago.

Fossil in the Pliocene and Pleistocene of Java and in the Pleistocene of Northern Celebes (Minahassa).

FAM. **FUSIDAE.**

92. **Fasciolaria trapezium** Linné sp..

1705 *Pseudo-Purpura*, Bastard Purper-Slek. Rumphius (100), p. 95, pl. XXIX, fig. E.
— Schynvoet in Rumphius (100), pl. XLIX, fig. K.
1758 *Murex trapezium*. Linné, Systema Naturae, edit. X, p. 755, nr. 493.
1767 — — Linné, Systema Naturae, edit. XII, p. 1224.
1791 — *Trapezium*. Gmelin, Syst. Nat. (27), p. 3552, nr. 99.
1822 *Fasciolaria trapezium*. Lamarck, An. s. vert. (52), vol. VII, p. 119, nr. 3.
1840 — — Kiener (32), vol. VI, Fasciolaria, p. 8, nr. 3, pl. 6.
1843 — — Lamarck, An. s. vert. (53), vol. IX, pp. 433—434.
1847 — — Reeve (97), vol. IV, Fasciolaria, species 16, pl. VII, fig. 15.
1876 — — Kobelt, Turbinella u. Fasciolaria (49), p. 131, pl. 10, figs. 1, 2.
1881 — — Tryon (109), vol. III, p. 77, pl. 61, fig. 26.
1887 — — Sowerby, Thesaurus (106), vol. V, p. 11, Fasciolaria, pl. III, fig. 22.
1894 — — L.. Horst et Schepman (31), p. 90.
1902 — — — von Martens, Rumphius Gedenkboek (71), pp. 118, 129.
1903 — — — Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 241, 270—271.
1911 — — — Schepman (104), p. 294.

Bay of Popoh, South coast, Resid. Kediri, 1 specimen.

Tjilatjap (Leyden Museum).

Distribution: Eastern part of the Archipelago: Amboina, Nusa-Laut-island near Amboina, Kelang west of Ceram, Waigeu.

— Philippine Is., China. — Red Sea and Gulf of Akabah, Perim-island in Strait of Bab-el-Mandeb (Museum Wageningen), Gulf of Aden, Zanzibar, Madagascar, Mauritius.

FAM. **MITRIDAE.**

93. **Turricula (s. str.) caffra** Linné sp..

1758 *Voluta caffra*. Linné, Systema Naturae, edit. X, p. 732.
1767 — — Linné, Syst. Nat., edit. XII, p. 1192.
1791 — — Gmelin, Syst. Nat. (27), p. 3451, nr. 51.
1811 *Mitra caffra*. Lamarck, Détermination des Mollusques; genres Volute, Mitre (Annales du Muséum, vol. XVII), p. 208, nr. 30.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 310, nr. 30.
1839 — — Kiener (32), vol. III, Mitra, p. 78, pl. 21, fig. 66.
1839 — — Küster, Volutacea (45), p. 56, pl. 10, figs. 6, 7.
1844 — — Lamarck, An. s. vert. (53), vol. X, pp. 318—319.
1844 — — Reeve (97), vol. II, Mitra, pl. III, fig. 20.
1874 — — Sowerby, Thesaurus (106), vol. IV, Mitra, pl. II, figs. 20, 21.
1882 *Turricula caffra*. Tryon (109), vol. IV, p. 167, pl. 49, fig. 409.
1894 *Turricula (Vulpecula) caffra*. Horst et Schepman (31), p. 79.
1902 *Mitra (Turricula) Caffra*. von Martens, Rumphius Gedenkboek (71), p. 119.
1915 *Turricula (Vulpecula) caffra*. Tesch, Timor (108), I, p. 47, pl. LXXX, fig. 101.

Shore of Bali-strait, north of Banjuwangi, 1 specimen.

Distribution: Eastern part of the Archipelago: Southern Celebes, Amboina, Buru.
— Singapore, Philippine Is..

Fossil in lower pleistocene or upper pliocene deposits of Timor.

FAM. **VOLUTIDAE.**

94. **Melo tessellata** Lamarck sp..

1811 *Voluta tessellata*. Lamarck, Détermination des Mollusques; genres Volute, Mitre (Annales du Muséum, vol. XVII), p. 58, nr. 4.

1822 *Voluta tessellata*. Lamarck, An. s. vert. (52), vol. VII, pp. 330—331, nr. 5.
1844 — — Lamarck, An. s. vert. (53), vol. X, p. 377.
1847 *Melo tessellatus*. Broderip in Sowerby, Thesaurus (106), vol. I, p. 413, pl. LXXXI, figs. 6—8.
1861 *Cymbium tessellatum*. Reeve (97), vol. XIII, Cymbium, species 10, pl. XVIII, figs. 10 a, b, c.
1882 *Melo tessellata*. Tryon (109), vol. IV, p. 80, pl. 23, figs. 15, 16.
1894 *Yetus (Melo) tessellatus*. Horst et Schepman (31), p. 66.

Bay of Popoh, South coast, Resid. Kediri, one large specimen measuring 16 cm..

Distribution: „Indian Ocean" (109). I could not find any definite locality.

95. **Voluta (Vespertilio) vespertilio** Linné.

1705 *Vespertilio*, Vleermuis. Rumphius (100), p. 103, pl. XXXII, figs. H, I.
1758 *Voluta vespertilio*. Linné, Systema Naturae, edit. X, p. 733, nr. 371.
1767 — — Linné, Syst. Nat., edit. XII, p. 1494.
1791 — *Vespertilio*. Gmelin, Syst. Nat. (27), p. 3461, nr. 97.
1811 — *vespertilio*. Lamarck, Détermination des Mollusques; genres Volute, Mitre (Annales du Muséum, vol. XVII), p. 63, nr. 16.
— — *pellis serpentis*. Lamarck, ibid., p. 63, nr. 15.
— — *mitis*. Lamarck, ibid., p. 64, nr. 17.
— — *serpentina*. Lamarck, ibid., p. 65, nr. 19.
1822 — *vespertilio*. Lamarck, An. s. vert. (52), vol. VII, pp. 336—337, nr. 17.
— — *pellis serpentis*. Lamarck, ibid., p. 336, nr. 16.
— — *mitis*. Lamarck, ibid., p. 337, nr. 18.
— — *serpentina*. Lamarck, ibid., p. 338, nr. 20.
1832 — *vespertilio*. Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. II, pp. 629—632, pl. 44, figs. 3—5.
1839 — *vespertilio*. Kiener (32), vol. III, Voluta, pp. 21, 22, nr. 16, pl. 20; pl. 22, fig. 1.
— — *pellis serpentis*. Kiener, ibid., p. 22, nr. 17, pl. 23.
— — *mitis*. Kiener, ibid., p. 24, nr. 18, pl. 24, figs. 1, 2.
1841 — — Lam.. Küster, Volutacea (45), pp. 190—191, nr. 38, pl. 22, fig. 4; pl. 33, figs. 3, 4.

1841 *Voluta pellis serpentis* Lam.. Küster, ibid., pp. 192—193, nr. 39, pl. 36, fig. 3.
— — *serpentina* Lam.. Küster, ibid., pp. 193—194, nr. 40, pl. 36, figs. 1, 2.
— — *Vespertilio* L.. Küster, ibid., pp. 197—200, nr. 44, pl. 20, fig. 5; pl. 22, figs. 1—3; pl. 28, figs. 7—8; pl. 34, figs. 1—4, 9, 10.
1844 — *vespertilio* Lin.. Deshayes in Lamarck, An. s. vert. (53), vol. X, p. 387, note 1.
1846 — *Vespertilio*. Sowerby, Thesaurus (106), vol. I, pp. 201—202, pl. XLVII, figs. 15—23; pl. LI, fig. 67.
1849 — *vespertilio* Linn.. Reeve (97), vol. VI, Voluta, pl. V, figs. 11 a, b, c, d.
1882 *Voluta (Vespertilio) vespertilio*. Tryon (109), vol. IV, p. 86, pl. 25, figs. 43—46, 48.
1894 *Voluta (Vespertilio) vespertilio* L. and vars. *pellis serpentis* Lam., *mitis* Lam. and *serpentina* Lam.. Horst et Schepman (31), pp. 66—68.
1902 *Voluta vespertilio* L., *pellis-serpentis* Lam. and var. *serpentina* Lam.. von Martens, Rumphius Gedenkboek (71), p. 121.
1907 *Voluta vespertilio* L., var. *pellis serpentis* Lam.. Schepman, Celebes (102a), p. 165.
1909 — — – Lamy, Java (56), p. 465.
1911 — — – and var. *pellis serpentis* Lam.. Schepman (104), p. 262.
1911 — — – var. *pellis serpentis* Lam.. K. Martin, Vorläuf. Bericht (74), pp. 19, 45.
1919 — — – K. Martin (75), pp. 79, 126, 128.

Shore of Bali-strait, north of Banjuwangi, 1 specimen of the typical form.
Shore near Panarukan, Resid. Besuki, 1 specimen, resembling in form *V. serpentina* of Lamarck, but in painting more like the typical *vespertilio*.

Distribution: East Indian Archipelago (especially on reefs): Banka, Borneo-bank (Strait of Makassar), Saleyer, Lombok, Flores, Timor, Roma-island N. of Timor, Banda, Amboina, Nusa-Laut-island near Amboina, Buru, Sula Is., Obi, Bachan, Halmahera, Waigeu, Misol, Kei Is., New Guinea.
— Sulu-archipelago, Philippines, Singapore. — Madagascar.

Fossil in the Lower and Upper Miocene of Java (Resid. Preanger) and in the Pleistocene of Northern Celebes (Minahassa).

FAM. MARGINELLIDAE.

96. **Marginella (Cryptospira) quinqueplicata** Lamarck.

1822 *Marginella quinqueplicata*. Lamarck, An. s. vert. (52), vol. VII, pp. 356—357, nr. 5.
1834 — — Kiener (32), vol. III, Marginella, p. 13, pl. 2, fig. 5.
1844 — — Lamarck, An. s. vert. (53), vol. X, pp. 437—438.
1846 — — Sowerby, Thesaurus (106), vol. I, p. 385, pl. LXXVII, figs. 145, 146.
1851 — *quinque plicata*. Petit de la Saussaye (81), p. 53.
1864 — *quinqueplicata*. Reeve (97), vol. XV, Marginella, species 40, pl. X, figs. 40 a, b, 41 a, b.
1878-'79 *Marginella (Cryptospira) quinqueplicata*. Weinkauff, Marginella u. Erato (113), pp. 3, 34, 141, pl. 1, fig. 1; pl. 5, figs. 10, 11.
1883 — — — Tryon (109), vol. V, p. 30, pl. 9, figs. 63, 64.
1887 — — — von Martens, Mergui (67), p. 184.
1894 — — — Horst et Schepman (31), p. 63.
1909 *Marginella quinqueplicata*. Lamy, Java (56), p. 465.
1912 *Marginella (Cryptospira) quinqueplicata*. K. Martin, Vorläuf. Bericht (74), p. 164.
1919 *Marginella quinqueplicata*. K. Martin (75), p. 78.

Coast near mouth of river Tji Lamaja, 2 specimens.
Surabaya, Harbour, mud; 19 specimens.
Distribution: East Indian Archipelago: Moluccas, Sumatra.

— Singapore, Malacca, Penang, Mergui-archipelago, Bay of Bengal.

Fossil in the Pliocene of Tjandi near Semarang, Java.

97. **Marginella (Cryptospira) dactylus** Lamarck.

1822 *Marginella dactylus*. Lamarck, An. s. vert. (52), vol. VII, p. 360, nr. 18.
1834 — — Kiener (32), vol. III, Marginella, p. 28, pl. 4, fig. 16.
1844 — — Lamarck, An. s. vert. (53), vol. X, p. 442.
1846 — — Sowerby, Thesaurus (106), vol. I, p. 401, pl. LXXVIII, fig. 187.
1851 — — Petit de la Saussaye (81), p. 55.
1864 — — Reeve (97), vol. XV, Marginella, species 42, pl. X, figs. 42 a, b.
1879 *Marginella (Volutella) dactylus*. Weinkauff, Marginella u. Erato (113), pp. 48, 141; pl. 8, figs. 13, 16.
1883 — — — Tryon (109), vol. V, p. 36, pl. 10, fig. 7.
1884 *Marginella velata*. K. Martin, Tiefbohr. Java (72), pp. 94—95, pl. V, fig. 95.
1895 *Marginella (Volutella) dactylus*. K. Martin, Foss. v. Java (73), p. 71, pl. X, fig. 161.
1911 — — — H. Martin–Icke, Trinil (76), p. 47.
1911 *Marginella (Cryptospira) dactylus*. Schepman (104), p. 261.
1919 *Marginella dactylus*. K. Martin (75), pp. 78, 124, 132, 145.

Surabaya, Harbour, mud, 3 specimens.
Madura-strait (Siboga expedition).
Distribution: Hongkong.
Fossil in the Upper Miocene and Pliocene of Java.

FAM. **OLIVIDAE.**

98. **Oliva elegans** Lamarck.

1810 *Oliva elegans*. Lamarck, Détermination des genres Farrière, Ancillaire et Olive, in: Annales du Muséum, vol. XVI, p. 312, nr. 11.

1822 *Oliva elegans*. Lamarck, An. s. vert. (52), vol. VII, p. 422, nr. 11.
1836-'39 — — Duclos, Monographie des Olives, pl. 21, figs. 1—6; pl. 32, figs. 1—2.
1844 — — Lamarck, An. s. vert. (53), vol. X, p. 611.
1842-'58 — — Duclos in Chenu, Illustrations conchyliologiques, pl. 23, figs. 1—6; pl. 34, figs. 1—2; pl. 35, fig. 11.
1850 — — Reeve (97), vol. VI, Oliva, pl. XII, figs. 20 a, b, c.
1857 — — Ducros de St. Germain, Revue critique Oliva (19), p. 44.
1871 — — Marrat in Sowerby, Thesaurus (106), vol. IV, Oliva, p. 15, pl. XI, figs. 158—160.
1871 — — Lischke, Japan. Meeresconch. (59), vol. II, p. 61.
1877 — — Weinkauff, Oliva (111), pp. 97—98, pl. 26, figs. 1—3, 5, 6.
1883 — — Tryon (109), vol. V, p. 76, pl. 20, figs. 81,82.
1894 — — Horst et Schepman (31), p. 47.
1902 — — von Martens, Rumphius Gedenkboek (71), p. 123.
1909 — — Lamy, Java (56), p. 465.
1911 — — Schepman (104), p. 250.

Bay of Popoh, South coast, Resid. Kediri. The only specimen belongs to a colour-variety with the waved streaks brownish red.

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Flores, Savu, Rotti, Timor, Amboina, Ceram, Buru, Obi, Gorontalo (Celebes), Misol, New Guinea.

North Western Australia, New Caledonia, Viti Is., Paumotu, Auckland (New Zealand). Philippines, China, Nagasaki (Japan). — Singapore, Madras, Ceylon, Red Sea.

99. **Oliva funebralis** Lamarck.

1810 *Oliva funebralis*. Lamarck, Détermination des genres Farrière, Ancillaire et Olive, in: Annales du Muséum, vol. XVI, p. 317, nr. 26.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 427, nr. 26.
1836-'39 *Oliva leucostoma*. Duclos, Monographie des Olives, pl. 27, figs. 14—16.

1844 *Oliva funebralis*. Lamarck, An. s. vert. (53), vol. X, p. 617.
1842-'58 *Oliva leucostoma*. Duclos in Chenu, Illustrations conchyliologiques, pl. 29, figs. 14—20.
1850 *Oliva Maura* Lam., var. *funebralis*. Reeve (97), vol. VI, Oliva, pl. VII, fig. 10 a.
1857 *Oliva funebralis*. Ducros de St. Germain, Revue critique Oliva (19), p. 41.
1871 *Oliva propinqua*. Marrat in Sowerby, Thesaurus (106), vol. IV, Oliva, p. 14, pl. XI, fig. 142.
— — *leucostoma* Duclos. Marrat, ibid., p. 14, pl. XI, figs. 143—145.
— — *Labradorensis* Bolten. Marrat, ibid., p. 14, pl. XI, figs. 146—148.
1876 *Oliva funebralis*. Weinkauff, Oliva (111), pp. 30—31, pl. 1, figs. 9, 10; pl. 9, figs. 4, 7, 8, 10.
1883 — — Tryon (109), vol. V, p. 77, pl. 21, figs. 97—99; pl. 22, figs. 100, 1, 2.
1894 — — Horst et Schepman (31), p. 48.
1895 — — K. Martin, Foss. v. Java (73), pp. 52, 53, pl. VIII, figs. 118, 119.
1909 — — Lamy, Java (56), p. 465.
1911 — — Schepman (104), p. 250.
1915 — — Tesch, Timor (108), I, p. 40, pl. LXXIX, fig. 85.
1919 — — K. Martin (75), pp. 76, 125, 131.

Shore near Panarukan, north coast of Resid. Besuki, 1 specimen.

North coast of Resid. Besuki (Leyden Museum). Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Southern Celebes, Amboina, Ceram, Misol, Aru-islands, New Guinea. — Viti Islands. — Philippines, Singapore, Ceylon.

Fossil in the Upper Miocene of Java (Preanger) and in the Pliocene of Java and Timor.

100. **Oliva mustelina** Lamarck.

1810 *Oliva mustelina*. Lamarck, Détermination des genres Farrière, Ancillaire et Olive, in: Annales du Muséum, vol. XVI, p. 316, nr. 24.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 426, nr. 24.

1836-'39 *Oliva mustelina*. Duclos, Monographie des Olives, pl. 20, figs. 1, 2.
1844 — — Lamarck, An. s. vert. (53), vol. X, p. 616.
1842-'58 — — Duclos in Chenu, Illustrations conchyliologiques, pl. 22, figs. 1, 2.
1850 — — Reeve (97), vol. VI, Oliva, pl. XIII, fig. 23.
1857 *Oliva mustellina*. Ducros de St. Germain, Revue critique Oliva (19), p. 57.
1869 *Oliva mustelina*. Lischke, Japan. Meeresconch. (59), vol. I, p. 69.
1871 — — Lischke, ibid., vol. II, p. 61.
1871 — — Marrat in Sowerby, Thesaurus (106), vol. IV, Oliva, p. 22, pl. XVII, figs. 272, 273.
1877 *Oliva mustellina*. Weinkauff, Oliva (111), pp. 92—93, pl. 24, figs. 10, 11.
1883 — — Tryon (109), vol. V, p. 78, pl. 22, fig. 6.
1894 *Oliva mustelina*. Horst et Schepman (31), p. 48.

Coast near mouth of river Tji Lamaja, 2 specimens. Distribution: Singapore, Philippines (114*a*), Hongkong, Amoy, Formosa, Nagasaki (Southern Japan).

FAM. **PLEUROTOMIDAE.**

101. **Surcula javana** Linné sp..

1767 *Murex javanus*. Linné, Systema Naturae, edit. XII, p. 1221, nr. 550.
1822 *Pleurotoma nodifera*. Lamarck, An. s. vert. (52), vol. VII, p. 96, nr. 23.
(?1832) — — Sowerby, Genera (105), Pleurotoma, fig. 1.
1839-'40 — — Kiener (32), vol. V, Pleurotoma, p. 22, pl. 12, fig. 1.
1843 — — Reeve (97), vol. I, Pleurotoma, pl. IV, fig. 28.
1843 — — Lamarck, An. s. vert. (53), vol. IX, pp. 353—355, nr. 23.
1875 *Pleurotoma (Surgula) javana* Linné. Weinkauff, Pleurotomidae (114), p. 39, pl. 8, fig. 5.
1884 *Surcula Javana*. Tryon (109), vol. VI, p. 237, pl. 5, fig. 63.

1884 *Pleurotoma (Surcula) nodifera* Lam.. K. Martin, Tiefbohr. Java (72), pp. 61, 62, pl. IV, fig. 61.
1894 *Surcula javana*. Horst et Schepman (31), p. 37.
1895 *Pleurotoma (Surcula) nodifera* Lam. var.. K. Martin, Foss. von Java (73), p. 27, pl. IV, figs. 67—69.
1909 *Surcula javana*. Lamy, Java (56), p. 465.
1915 *Pleurotoma (Surcula) nodifera* Lam.. Tesch, Timor (108), I, p. 28, pl. LXXVIII, figs. 57, 58.
1919 *Surcula nodifera* Lamk., var.. K. Martin (75), pp. 73, 124, 125.
Not *Pleurotoma Javana* Reeve; Kiener.

Coast near mouth of river Tji Lamaja, 6 specimens.
Distribution: Singkep (N. of Banka).
— Singapore, Straits of Malacca, Japan.
Fossil in the Upper Miocene, Pliocene and Pleistocene of Java and in the Pliocene of Timor.

FAM. **CONIDAE.**

In arranging the *Conidae* I have chiefly followed Cossmann ((12), II, pp. 142—163), but I cannot agree with that author in considering *Hermes* to be a distinct genus merely on conchological characters.

102. **Conus (s. str.) roseus** Lamarck.

1810 *Conus roseus*. Lamarck, Description des espèces du genre Cône (Annales du Muséum, vol. XV), p. 37, nr. 32.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 458, nr. 32.
1843 — — Reeve (97), vol. I, Conus, species 186, pl. XXXIII, fig. 186.
1845 — — Lamarck, An. s. vert. (53), vol. XI, p. 32, nr. 32.
1846 — — Kiener (32), vol. II, Conus, p. 22, pl. 9, fig. 3.
1858 — — Sowerby, Thesaurus (106), vol. III, p. 8, pl. 5, figs. 94, 95.

1873 *Conus roseus*. Weinkauff, Conus (51), p. 130, pl. 25, fig. 8; pl. 29, figs. 3, 4.
1884 *Conus (Mures) mus* Hwass, var. *roseus* Lam.. Tryon (109), vol. VI, p. 20, pl. 5, fig. 73.
1894 — — *roseus* Lamarck. Horst et Schepman (31), p. 14.
1913 — — — Schepman (104), p. 380.

Tji Solok, Wijnkoopsbay, 5 specimens.
Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Borneo, Rotti-island near Timor, Amboina.

Our specimens from Tji Solok confirm once more the eastern habitat of this species, pointed out already by Schepman, though Lamarck, Reeve, Sowerby and Weinkauff give as habitat „West-Indies".

103. **Conus (s. str.) coronatus** Dillwyn.

1817 *Conus coronatus*. Dillwyn, A descriptive Catalogue of recent shells, arranged according to the Linnaean method, vol. I, p. 403, nr. 91.
1843 *Conus minimus*. Reeve (97), vol. I, Conus, pl. XXVI, fig. 143 a.
1873 *Conus coronatus*. Weinkauff, Conus (51), p. 131, pl. 28, figs. 5, 6.
1884 *Conus (Mures) miliaris* Hwass, pars. Tryon (109), vol. VI, p. 21, pl. 5, fig. 88; pl. 27, fig. 12.
1894 *Conus (Mures) coronatus* Dillwyn. Horst et Schepman (31), p. 15.
1897 *Conus coronatus* Dillw.. von Martens (69), p. 290.

Shore near Panarukan, north coast of Resid. Besuki, 1 specimen.
Tjilatjap (Leyden Museum).

Distribution: Sumatra: near Padang (coralreef); Olehleh, Achin, N. Sumatra (Museum Wageningen). Timor. — Cochin-China, Philippines, New Caledonia, Paumotu, Hawaii, Galapagos Is.. — Ceylon, Aden.

The specimen from Panarukan agrees with the quoted figures. I have not cited Schepman (104), as he quotes also plate 5, fig. 84 of Tryon, representing *Conus miliaris* Hwass.

Tryon made *C. coronatus* a synonym of *C. miliaris*. In the latter species the spire is however much less high.

104. **Conus (Lithoconus) virgo** Linné.

1705 *Cereola*. Rumphius (100), pl. XXXI, fig. E.
1758 *Conus virgo*. Linné, Systema Naturae, edit. X, p. 713.
1767 — — Linné, Syst. Nat., edit. XII, p. 1166.
1791 — *Virgo*. Gmelin, Syst. Nat. (27), p. 3376, nr. 5.
1822 — *virgo*. Lamarck, An. s. vert. (52), vol. VII, p. 468, nr. 58.
1843 — — Reeve (97), vol. I, Conus, species 119, pl. XXI, fig. 119.
1845 — — Lamarck, An. s. vert. (53), vol. XI, p. 46, nr. 58.
1847 — — Kiener (32), vol. II, Conus, p. 95, pl. 36, fig. 1.
1858 — — Sowerby, Thesaurus (106), vol. III, p. 23, pl. 8, fig. 167.
(1838) 1874 *Conus virgo*. Küster–Weinkauff, Conus (51), pp. 110, 268, pl. 45, fig. 5.
1884 *Conus (Virgines) Virgo* Linn.. Tryon (109), vol. VI, p. 43, pl. 13, fig. 45.
1894 — — *virgo* — Horst et Schepman (31), p. 21.
1902 *Conus virgo*. von Martens, Rumphius Gedenkboek (71), p. 120.
1903 — — L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 249, 274—275.
1919 — — K. Martin (75), p. 72.

Shore near Panarukan, Resid. Besuki, 1 specimen. Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Banka, Flores, Timor, Amboina, Ceram, Northern Celebes.
— Philippine Is.. — New Caledonia, Viti Is., Samoa.
— Ceylon, Gulf of Aden, Red Sea and Gulf of Suez, Seychelles, Mauritius, Réunion, Nossi-Bé near Madagascar, Zanzibar, Mozambique.

Fossil in the Upper Miocene of Java.

105. **Conus (Chelyconus) magus** Linné.

1758 *Conus magus*. Linné, Systema Naturae, edit. X, p. 716, nr. 276.

1789 *Conus indicus*. Chemnitz, Conchylien-Cabinet, vol. X, p. 36, pl. 140, fig. 1295.
— — *clandestinus*. Chemnitz, ibid., p. 37, pl. 140, fig. 1296.
1792 — *raphanus*. Hwass in Bruguière, Encycl. (10), vol. I, part 2, p. 722, nr. 118, pl. 341, fig. 2.
— — *magus*. Hwass, ibid., p. 723, nr. 119, pl. 341, fig. 8.
1795 *Conus Circae*. Chemnitz, Conchylien-Cabinet, vol. XI, pl. 183, figs. 1778—1779.
1822 — *raphanus*. Lamarck, An. s. vert. (52), vol. VII, p. 508, nr. 147.
— — *magus*. Lamarck, ibid., p. 509, nr. 148.
1834 — *raphanus*. Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. III, p. 85, pl. 52, fig. 1.
1837 — — Hwass. Küster, Conus (51), pp. 13—14, pl. 2, fig. 3.
1838 — *magus* L.. Küster, ibid., pp. 36—37, pl. 6, figs. 1, 3; pl. 15, figs. 3, 4; pl. 19, figs. 5, 6.
1843 — — – Reeve (97), vol. I, Conus, pl. XXXV, figs. 190 a—e.
1844 — *epistomium*. Reeve, ibid., pl. XLII, figs. 227 a, b.
1845 — *magus* L.. Deshayes in Lamarck, An. s. vert. (53), vol. XI, p. 103, note 1.
1849 — *striolatus*. Kiener (32), vol. II, Conus, pl. 105, fig. 1.
1849 — — Kiener. Reeve (97), Conus, Suppl. plate VI, fig. 262.
1849-'50 – *magus* L.. Kiener (32), vol. II, Conus, p. 283, pl. 67, figs. 1, 1 a—c.
1853 — *assimilis*. A. Adams in: Proceedings Zoolog. Society, p. 118.
1858 — *magus* L.. Sowerby, Thesaurus (106), vol. III, p. 38, pl. 21, figs. 508—512.
— — *raphanus* Brug.. Sowerby, ibid., p. 36, pl. 20, fig. 494.
— — *circae*. Sowerby, ibid., p. 39, pl. 21, figs. 513—514; pl. 22, fig. 525.
— — *epistomium* Rve.. Sowerby, ibid., p. 39, pl. 21, fig. 515.
— — *assimilis* A. Ad.. Sowerby, ibid., p. 38, pl. 21, fig. 505.
1864 — *Consul*. Boivin in: Journal de Conchyliologie, vol. XII, p. 33, pl. 1, figs. 5, 6.
1865 — *Frauenfeldi*. Crosse in: Journ. de Conchyl., vol. XIII, p. 311, pl. 10, figs. 1, 1 a.

1866 *Conus Tasmaniae.* Sowerby, Thesaurus (106), vol. III, p. 328, pl. XXVII, fig. 636.
— — *Borneensis* Sowb. (*not* of A. Adams and Reeve). Sowerby, ibid., p. 329, pl. XXVIII, fig. 648.
— — *consul* Boivin. Sowerby, ibid., p. 330, pl. 21, fig. 509 (as *magus*).
— — *Frauenfeldi* Crosse. Sowerby, ibid., p. 330, pl. 21, fig. 514; pl. 22, fig. 525 (as *circae*).
— — *striolatus* Rve.. Sowerby, ibid., p. 330, pl. 14, figs. 327, 328 (as *ustulatus*).
1873-'75 — *magus* L.. Weinkauff, Conus (51), pp. 141, 146, 316, pl. 57, figs. 8—11.
1876 — — — E. A. Smith, A list of Marine Shells, chiefly from the Solomon Islands (104*bis*) pp. 535—536.
1884 — *(Magi) magus* L. and vars. *Frauenfeldi* Crosse and *epistomium* Rve.. Tryon (109), vol. VI, pp. 53—54, pl. 15, figs. 3—9; pl. 16, figs. 12, 13.
1894 — — — — and vars. *raphanus* Brug., *frauenfeldi* Crosse, *circae* Chemn. and *indicus* Chemn.. Horst et Schepman (31), pp. 23—24.
1907 — *magus* L.. Schepman, Celebes (102a), pp. 155—156.
1909 — — — Lamy, Java (56), p. 464.
1913 — *(Magi) magus* L. and var. *raphanus* Hwass. Schepman, Siboga exp. (104), p. 388.

Shore of Bali-strait, north of Banjuwangi, 1 specimen, belonging to the form without longitudinal flames (Küster, pl. 2, fig. 3; Reeve, fig. 190 e; Kiener, fig. 1 c; Sowerby, Thesaurus, fig. 494). This is the *Conus raphanus* of authors, but perhaps not the form meant by Hwass.

Tjilatjap (Leyden Museum).

Distribution: East Indian Archipelago: Billiton, Borneo, Flores, Timor, Amboina, Nusa-Laut-island near Amboina, Ceram, Gisser east of Ceram, Waigeu, New Guinea.

— North Australia, Vanikoro (Santa Cruz islands, Melanesia), New Caledonia, Paumotu, Caroline Islands, Philippine Is., Singapore.

— Mauritius, Madagascar.

Fossil in the Pleistocene of Northern Celebes (Minahassa).

Probably *C. consors* Sow. is also only a form of *Conus magus*, as the distinguishing characters (broader spire, contraction in the centre and the absence of the encircling chocolate interrupted lines) do not seem to be constant.

106. **Conus** (**Chelyconus**) **achatinus** Chemnitz.

1705 Achaat-hoorn. Schynvoet in Rumphius (100), pl. XXXIV, fig. L.
1789 *Conus achatinus maximus*. Chemnitz, Neues systematisches Conchylien-Cabinet, vol. X, pl. 142, fig. 1317.
1822 *Conus achatinus*. Lamarck, An. s. vert. (52), vol. VII, p. 480, nr. 79.
1843 — — Reeve (97), vol. I, Conus, pl. XXXV, figs. 191 a, b.
1845 — — Chemn.. Lamarck, An. s. vert. (53), vol. XI, p. 62, nr. 79.
1848 — — Kiener (32), vol. II, Conus, p. 188, pl. 40, fig. 1.
1858 — — Sowerby, Thesaurus (106), vol. III, p. 38, pl. 15, figs. 335, 336.
(1838) 1873 *Conus achatinus* Hwass. Küster–Weinkauff, Conus (51), pp. 32, 145, pl. 5, figs. 3, 9.
1884 *Conus (Achatini) achatinus* (Chemn.), Auct.. Tryon (109), vol. VI, p. 64, pl. 20, figs. 11, 12.
1894 — — — Horst et Schepman (31), p. 27.
1902 — *achatinus* Chemn.. von Martens, Rumphius Gedenkboek (71), p. 121.
1907 — — — Schepman, Celebes (102a), p. 156.
1909 — — — Lamy, Java (56), p. 464.

Tji Solok, Wijnkoopsbay, 2 specimens.
Tjilatjap (Leyden Museum).
Distribution: Amboina.
— Singapore; India; China. — Australia; Solomon Is..
Fossil in the Pleistocene of Northern Celebes (Minahassa).

107. **Conus** (**Leptoconus**) **vexillum** Martini.

1773 *Conus vexillum*. Martini, Neues systematisches Conchylien-Cabinet, vol. II, pl. 57, fig. 629.

1791 *Conus Vexillum.* Gmelin, Syst. Nat. (27), p. 3397, nr. 68.
1822 — *vexillum.* Lamarck, An. s. vert. (52), vol. VII, pp. 471—472, nr. 65 (exclusive of var. b).
1843 — — Martini. Reeve (97), vol. I, Conus, pl. I, fig. 3.
1845 — — — Lamarck, An. s. vert. (53), vol. XI, p. 51, nr. 65 (exclusive of var. b).
1847 — — Kiener (32), vol. II, Conus, p. 79, pl. 34, fig. 1.
1858 — — Sowerby, Thesaurus (106), vol. III, p. 27, pl. 7, fig. 163.
1859 — — Chenu, Manuel (11), vol. I, p. 250, fig. 1538.
(1838) 1873 *Conus vexillum* Gmelin. Küster–Weinkauff, Conus (51), pp. 83, 163, pl. 17, fig. 13.
1884 *Conus (Capitanei) vexillum* Gmelin. Tryon (109), vol. VI, p. 39, pl. 11, fig. 12 a.
1894 — — — — Horst et Schepman (31), p. 20.
1907 *Conus vexillum* Gmelin. Couturier, Tahiti,etc. (13), p. 128.
1909 — — Martini. Lamy, Java (56), p. 464.
1913 — *(Capitanei) vexillum* Gmel.. Schepman (104), p. 384.

Java (without exact locality), 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: East Indian Archipelago: Borneo-bank (Strait of Makassar), Timor, Amboina, Ceram.
— New Caledonia, Samoa, Society Is., Paumotu. — Philippine Is., Cochin China, Ceylon, Malabar Coast, Madagascar, E. Africa.

108. **Conus (Hermes) nussatella** Linné.

1705 *Terebellum granulatum.* Rumphius (100), pl. XXXIII, fig. EE.
1758 *Conus nussatella.* Linné, Systema Naturae, edit. X, p. 716.
1767 — — Linné, Syst. Nat., edit. XII, p. 1170, nr. 314.
1789 *Conus terebra.* Chemnitz, Neues systematisches Conchylien-Cabinet, vol. X, p. 81, pl. 143, fig. 1329.
1822 *Conus nussatella.* Lamarck, An. s. vert. (52), vol. VII, p. 515, nr. 162.

1823 *Conus Nussatella*. Sowerby, Genera (105), Conus, fig. 7.
1843 — — Reeve (97), vol. I, Conus, pl. XI, fig. 56.
1845 — *nussatella*. Lamarck, An. s. vert. (53), vol. XI, pp. 113—114, nr. 162.
1849-'50 — — Kiener (32), vol. II, Conus, p. 299, pl. 53, fig. 2.
1858 *Conus nussatella*. Sowerby, Thesaurus (106), vol. III, p. 45, pl. 23, figs. 553, 554.
1859 — — Chenu, Manuel (11), vol. I, p. 252, fig. 1561.
(1838) 1873 — — Küster–Weinkauff, Conus (51), pp. 43, 151, pl. 7, fig. 3.
1884 *Conus (Terebri) nussatella* Linn.. Tryon (109), vol. VI, p. 80, pl. 25, fig. 35.
1894 — — — — Horst et Schepman (31), p. 30.
1899 — *(Hermes)* — — Melvill and Standen, TorresStraits (77), p. 156.
1902 *Conus Nussatella*. von Martens, Rumphius Gedenkboek (71), p. 121.
1903 — *nussatella* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 250, 274—275.
1907 — — — Couturier, Tahiti, etc. (13), p. 129.
1913 — *(Terebri) nussatella*. Schepman (104), p. 394.

Coral-island Pulu Pandjang, 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: East Indian Archipelago: Nussatella-islands (3 Brothers or Nusa-telu) near the west coast of Amboina, after which the species has been named; Nusa-Laut-island near Amboina; Banka; New Guinea.
— Torres Straits, Northern Australia, New Caledonia, Paumotu.
— Philippine Is., China. — Ceylon, Gulf of Aden, Red Sea, Gulf of Suez and Gulf of Akabah, E. Africa.

109. **Conus (Hermes) scabriusculus** Chemnitz.

1795 *Conus scabriusculus*. Chemnitz, Neues systematisches Conchylien-Cabinet, vol. XI, p. 56, pl. 182, figs. 1768, 1769.
1832-'42 *Conus fabula*. Sowerby, Conchological Illustrations, pl. I, fig. 5.

1843 *Conus fabula* Sowerby. Reeve (97), vol. I, Conus, pl. XXVI, figs. 147 a, b.
1845 — — Sow.. Deshayes in Lamarck, An. s. vert. (53), vol. XI, pp. 147—148.
1848 — — Kiener (32), vol. II, Conus, p. 201, pl. 78, figs. 2, 2 a.
1858 *Conus scabriusculus*. Sowerby, Thesaurus (106), vol. III, p. 46, pl. 22, figs. 542, 543.
1873, 1875 *Conus scabriusculus*. Weinkauff, Conus (51), pp. 138, 320, pl. 26, figs. 14, 15; pl. 58, fig. 9.
1884 *Conus (Terebri) scabriusculus* Chemn.. Tryon (109), vol. VI, p. 80, pl. 25, fig. 29.
1894 — — — — Horst et Schepman (31),p. 30.

Tji Solok, Wijnkoopsbay, 1 specimen.
Tjilatjap (Leyden Museum).
Distribution: Amboina.
— Philippine Is., Japan, Caroline Is., New Caledonia, Australia.

110. **Conus (Cylindrus) canonicus** Hwass.

1792 *Conus canonicus*. Hwass in Bruguière, Encyclopédie méthodique (10), vol. I, part 2, p. 749, pl. 345, fig. 1.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 522, nr. 174.
1843 — — Hwass. Reeve (97), vol. I, Conus, pl. XXIX, figs. 165 a, b.
1845 — — Brug.. Lamarck, An. s. vert. (53), vol. XI, p. 121, nr. 174.
1849-'50 — Kiener (32), vol. II, Conus, p. 335, pl. 95, fig. 1.
1858 — — Brug.. Sowerby, Thesaurus (106), vol. III, p. 42, nr. 360, pl. 23, fig. 568.
1874 — *Canonicus*. Weinkauff, Conus (51), p. 299, pl. 53, figs. 7—9.
1884 *Conus (Texti) textile* L., var. *archiepiscopus* Hwass, pars. Tryon (109), vol. VI, p. 90, pl. 30, fig. 2.

1894 *Conus (Texti) canonicus* Brug.. Horst et Schepman (31), p. 34.
1899 — *(Textile) canonicus* Hwass. Melvill and Standen, Torres Straits (77), p. 156.
1902 — *canonicus* Hwass. von Martens, Rumphius Gedenkboek (71), p. 121.
1913 — *(Texti) canonicus* Hwass. Schepman (104), p. 397.
1919 — *canonicus* Brug.. K. Martin (75), p. 73.

Tji Solok, Wijnkoopsbay, 1 young specimen.
Tjilatjap (Leyden Museum).
Distribution: East Indian Archipelago: Banka, Amboina, Nusa-Laut-island near Amboina, Ceram, Bachan, Talaut-islands N. E. of Celebes.
— Torres Straits, Australia, Pacific. — Philippines, Ceylon.
Fossil in the Miocene of Java.

111. **Conus (Cylindrus) abbas** Hwass.

1792 *Conus abbas.* Hwass in Bruguière, Encycl. méth. (10), vol. I, part 2, p. 750, pl. 345, fig. 3.
1822 — — Lamarck, An. s. vert. (52), vol. VII, p. 523, nr. 176.
1843 — — Hwass. Reeve (97), vol. I, Conus, species 162, pl. XXVIII, fig. 162; pl. XXXII, fig. 162 b.
1845 — — Brug.. Lamarck, An. s. vert. (53), vol. XI, pp. 122—123, nr. 176.
1858 — — — Sowerby, Thesaurus (106), vol. III, p. 42, pl. 23, fig. 575.
(1838) 1873 *Conus abbas.* Küster–Weinkauff, Conus (51), pp. 47, 152.
1884 *Conus (Texti) abbas* Hwass. Tryon (109), vol. VI, p. 92, pl. 30, fig. 12.
1894 — — — Brug.. Horst et Schepman (31), p. 34.

Tji Solok, Wijnkoopsbay, 1 specimen.
Distribution: Amboina.
— New Caledonia. — Philippines, Ceylon, Madagascar, E. Africa.

OPISTHOBRANCHIA.

FAM. **BULLIDAE.**

112. **Bulla ampulla** Linné.

1705 *Bulla*. Rumphius (100), p. 91, pl. XXVII, fig. G.
1767 *Bulla ampulla*. Linné, Systema Naturae, edit. XII, p. 1183.
1822 — — Lamarck, An. s. vert. (52), vol. VI, 2nd part, p. 33, nr. 2.
(?1833) *Bulla Ampulla*. Sowerby, Genera (105), Bulla, fig. 4.
1836 *Bulla ampulla* Lin.. Lamarck, An. s. vert. (53), vol. VII, p. 668, nr. 2.
1850 — — A. Adams in Sowerby, Thesaurus (106), vol. II, p. 575, pl. CXXII, figs. 59—62.
1854 — *columellaris* and var. *bifasciata*. Menke in: Malacozoologische Blätter, I, pp. 26, 43.
1868 — *ampulla* L.. Sowerby in Reeve (97), vol. XVI, Bulla, pl. I, figs. 3 a, b, c.
— — *trifasciata*. Sowerby, ibid., pl. I, fig. 1.
1887 — *ampulla*. von Martens, Mergui (67), p. 199.
1893 *Bulla ampulla* L. and vars. *bifasciata* Menke and *trifasciata* Sowb.. Pilsbry (109), vol. XV, pp. 343—345, pl. 34, figs. 1—5.
1895 *Bulla (s. str.) ampulla* Linn.. K. Martin, Foss. v. Java (73), p. 8, pl. I, figs. 2, 2a, 3.
1896 *Bulla ampulla* L.. Kobelt, Bullidae (33), pp. 72—73, pl. 1, figs. 5—7.
1897 — — – von Martens, Süss- u. Brackw. Moll. Ind. Arch. (69), p. 291.
1902 — — – von Martens, Rumphius Gedenkboek (71), p. 117.
1903 — — – Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 268, 282—283.
1907 — — – Couturier, Tahiti, etc. (13), p. 173.
1911 — — – H. Martin-Icke, Trinil (76), p. 46.
1911 — — – K. Martin, Vorläuf. Bericht (74), p. 44.
1913 — — – Schepman (104), p. 473.
1919 — — – K. Martin (75), pp. 70, 128, 131, 141.

Shore of Bali-strait, north of Banjuwangi, 1 specimen without bands and 1 shell with two darker bands (form *bifasciata* Menke).

Surabaya, shore of Bandjaran, 1 specimen of the form *bifasciata*.

Djangkar, north coast of Resid. Besuki (Siboga expedition).

Distribution: East Indian Archipelago: East coast of Borneo, Saleyer, Gorontalo (Celebes), Lombok, Flores, Rotti-island, Timor, Lucipara Is., Amboina, Ceram, Sula Is., Bachan. — Philippines. — New South Wales, Viti Is., Paumotu. — Singapore, Salang-island, Mergui-archipelago, Ceylon, Gulf of Aden, Red Sea, Gulf of Suez and Gulf of Akabah, Seychelles, Amirantes, Mauritius, Réunion, Madagascar, Natal.

Fossil in the Upper Miocene and in the Pliocene of Java.

113. **Bulla adamsi** (?Menke) Brazier.

1850 *Bulla australis* (*nec* Quoy et Gaimard). A. Adams in Sowerby, Thesaurus (106), vol. II, p. 576, pl. CXXII, figs. 64—66.

?[1850 *Bulla adamsii*. Menke in: Zeitschrift für Malakozoologie, 1850, p. 162].

?[1854 — — Menke in: Malacozoologische Blätter, I, p. 43].

1868 *Bulla australis* (*nec* Quoy et Gaimard). Sowerby in Reeve (97), vol. XVI, Bulla, pl. IV, figs. 12 a, b, c.

1885 *Bulla adamsi*. Brazier in: Proceedings of the Linnean Society of New South Wales, vol. X, p. 92.

1893 — — Menke. Pilsbry (109), vol. XV, pp. 345—346 (cfr. p. 342), pl. 35, figs. 15, 16, 19, 20.

1896 — *adamsii* — Kobelt, Bullidae (33), pp. 75—76, pl. 8, figs. 3, 4.

1899 — *Adamsi* — Melvill and Standen, Torres Straits (77), p. 155.

1909 — — — Lamy, Java (56), p. 467.

Shore near Panarukan, Resid. Besuki, 1 specimen. The shell agrees rather well with figure 65 in Sowerby's Thesaurus. Among the four bands the third is rather indistinct.

Distribution: Islands in Torres Straits and off N. E. Australia, Tonga Is., Tahiti (on the reefs).

FAM. **SCAPHANDRIDAE.**

114. **Atys (s. str.) naucum** Linné sp..

1705 *Bulla*. Rumphius (100), p. 91, pl. XXVII, fig. H.
1758 *Bulla naucum*. Linné, Systema Naturae, edit. X, p. 726.
1850 *Bulla (Atys) naucum* L.. A. Adams in Sowerby, Thesaurus (106), vol. II, p. 584, pl. CXXIV, figs. 107—109.
1869 *Atys Naucum* L.. Sowerby in Reeve (97), vol. XVII, Atys, pl. I, figs. 1 a, b, c.
1893 — *(s. str.) naucum* L.. Pilsbry (109), vol. XV, pp. 263—264, pl. 28, figs. 11—13.
1895 — *naucum* L.. Kobelt, Bullidae (33), pp. 13—15, pl. 2, figs. 13, 14.
1902 *Bulla (Atys) naucum* L.. von Martens, Rumphius Gedenkboek (71), p. 117.
1903 *Atys naucum* L.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 267, 282—283.
1906 — — — K. Martin, Foss. v. Java (73), p. 283, pl. XLII, fig. 677.
1909 — — — Lamy, Java (56), p. 467.
1911 — — — H. Martin-Icke, Trinil (76), p. 46.
1913 — — — Schepman (104), p. 467.
1919 — — — K. Martin (75), pp. 70, 131.

Shore near Panarukan, Resid. Besuki, 1 specimen.

Distribution: East Indian Archipelago: Borneo (on muddy sand-banks), Sumbawa, Flores, Banda, E. coast of Halmahera (Museum Wageningen).

— Torres Straits, eastward to Viti Is.. — Philippines, Singapore.

— Indian Ocean, westward to Mauritius, Réunion, Madagascar, the Gulf of Aden and the Red Sea (with the Gulf of Suez and the Gulf of Akabah).

Fossil in the Pliocene of Java.

115. **Atys (Alicula) cylindrica** Helbling sp..

1779 *Bulla cylindrica*. Helbling, Beiträge zur Kenntniss neuer Conchylien, in: Abhandlungen einer Privatgesellschaft in Böhmen, zur Aufnahme der Mathematik, der Vaterl. Geschichte und der Naturgeschichte, Band IV, p. 122, nr. 18, pl. II, figs. 30, 31.

1789 *Bulla cylindrica*. Chemnitz, Neues systematisches Conchylien-Cabinet, vol. X, pp. 113, 121, pl. 146, figs. 1356, 1357.
1850 *Bulla (Atys) cylindrica* Helblings. A. Adams in Sowerby, Thesaurus(106), vol. II, p. 585, pl. CXXV, fig. 114.
— — — *elongata*. A. Adams, ibid., p. 587, pl. CXXV, fig. 121.
1869 *Atys cylindrica* Heblings. Sowerby in Reeve (97), vol. XVII, Atys, pl. II, figs. 7 a, b.
— — *elongata* A. Adams. Sowerby, ibid., pl. II, figs. 8 a, b.
1893 *Atys (Alicula) cylindrica* Helbling. Pilsbry (109), vol. XV, pp. 265—266, pl. 33, figs. 60—62.
1895 *Atys cylindrica* Helbling. Kobelt, Bullidae (33), pp. 16—17, pl. 2, figs. 15, 16.
1895 *Bulla (Atys) cylindrica* Hebl.. K. Martin, Foss. v. Java (73), p. 8, pl. I, fig. 1.
1899 *Atys (Alicula) cylindrica* Helbling. Melvill and Standen, Torres Straits (77), p. 155.
1901 *Atys cylindrica* Helbling sp.. H. Fischer, Djibouti, etc. (22*a*), p. 98.
1903 — — Helbl.. Sturany, Gastropoden des Rothen Meeres (107*a*), pp. 268, 282—283.
1907 — — Helbling. Couturier, Tahiti, etc. (13), p. 174.
1911 — — Hebl.. H. Martin—Icke, Trinil (76), p. 46.
1913 — *(Alicula) cylindrica* Helbling and var. *elongata* A. Ads.. Schepman (104), p. 469.
1919 *Roxania (Alicula) cylindrica* Hebl.. K. Martin (75), pp. 70, 141.

Shore near Panarukan, Resid. Besuki, 1 specimen of the typical form. Alt. 26, diameter 13 mill..

Near reef of Batjulmati, East coast (Siboga expedition).

Distribution: East Indian Archipelago: Sumbawa, Paternoster-islands, Savu, Rotti-island, Roma-island, Banda, Manipa-island between Ceram and Buru, Talaut Is. N. E. of Celebes. — Philippines (in sandy mud). — Torres Straits, Viti Is., Paumotu. — Andamans, Ceylon, Gulf of Aden, Jibuti (Somaliland), Red Sea, Gulf of Suez and Gulf of Akabah, Seychelles, Mauritius.

Fossil in the Pliocene of Java.

PULMONATA.

FAM. AURICULIDAE.

116. **Pythia plicata** Férussac sp..

1819-?'30 *Scarabus plicatus*. Férussac, Prodrome, p. 101, nr. 2.
1830 — — Lesson, Voyage de la Coquille, Zoologie, vol. II, p. 335.
1838 *Auricula plicata* Desh.. Deshayes in Lamarck, An. s. vert. (53), vol. VIII, pp. 339—340, nr. 30.
1860 *Scarabus plicatus* Férussac. Reeve (97), vol. XII, Scarabus, pl. III, fig. 28.
1897 *Pythia plicata* Fer.. von Martens, Süss- u. Brackw. Moll. Ind. Arch. (69), pp. 131—133.
1914 — — Leschke, Java u. Celebes (58), p. 247.
1921 — — (Fer.). Prashad, Sumatra (95), p. 467.

Coral-island Pulu Pandjang, 3 specimens.
Surabaya, shore of Bandjaran, 1 specimen.
Surabaya (von Martens).

Distribution: East Indian Archipelago: Belawan (Deli, Sumatra), in mangrove-swamps; N. W. coast of Borneo. — Bangkok (Siam); Pulo Penang; Moulmein and Rangoon (Burma); Irrawady Delta; Bengal; Coromandel Coast; Ceylon (in saline marshes).

117. **Pythia pantherina** A. Adams sp..

1849 *Scarabus pyramidatus* (*not* of Reeve), var. *javanica*. Mousson, Java (79), p. 49, pl. V, fig. 10.
1850 *Scarabus pantherinus*. A. Adams in: Proceedings Zoological Society, London, 1850, p. 152.
1856 *Pythia pantherina* (A. Ad.). Pfeiffer, Monogr. Auricul. (83), p. 94.
1891 *Scarabus pantherinus* (A. Ad.). O. Boettger (6), pp. 275—276.

1897 *Pythia pantherina* (A. Ad.). von Martens (69), pp. 136—138.
1908 — — — C. R. Boettger, Amboina (4), p. 184.
1914 — — Leschke, Java u. Celebes (58), p. 247.

Mantjingan, south coast (Resid. Djocjakarta), 8 specimens.

Anjer, coast of Sunda-strait (von Martens). South coast of Residency Bantam, W. Java (van Hasselt). Nusa-Barung-island near south coast of E. Java (Zollinger).

Distribution: East Indian Archipelago: Sumatra (Benkulen, Tiku north of Padang), Borneo, Celebes, Amboina, Haruku and Saparua near Amboina, Ceram, New Guinea. — Philippines. — Nicobars, Ceylon.

118. **Cassidula auris-felis** Bruguière sp..

1786 *Voluta Coffea Linnaei.* Chemnitz (not of Linné), Conchylien-Cabinet, vol. IX, 2, p. 45, pl. 121, figs. 1043—1044.
1789 *Bulimus auris felis.* Bruguière, Encycl. méth. (10), vol I, part 1, p. 343, pl. 460, figs. 5 a, b.
1822 *Auricula felis.* Lamarck, An. s. vert. (52), vol. VI, 2 nd part, pp. 138—139, nr. 5.
1838 — — Lamk.. Deshayes in Lamarck, An. s. vert. (53), vol. VIII, p. 326, nr. 5.
1838 — — Lk.. Potiez et Michaud, Galérie des Mollusques, ou Catalogue méthodique, descriptif et raisonné des mollusques et coquilles du Muséum de Douai, I, p. 201.
1841 *Auricula fusca.* Hombron et Jacquinot, Voyage au Pôle Sud, pl. 9, figs. 7—9.
1841 — *Felis.* Küster, Auriculacea (47), p. 16, pl. 3, fig. 3.
1847 *Cassidula auris felis* Br.. Gray in: Proceedings Zoological Society, London, p. 179.
1852 *Auricula felis* Lk.. Souleyet, Voyage de la Bonite (20), vol. II, p. 516, pl. 29, figs. 21—23.
1854 — *fusca.* Rousseau in Hombron et Jacquinot, Voyage au Pôle Sud, p. 34.
1856 *Cassidula auris felis* Br.. Pfeiffer, Monogr. Auricul. (83), p. 117.

1876 *Cassidula auris felis* Br.. Pfeiffer, Monographia Pneumonopomorum viventium; Suppl. III, p. 354.
1878 *Auricula felis* Lk.. Sowerby in Reeve (97), vol. XX, Auricula, pl. IV, fig. 25.
1887 *Cassidula auris-felis* Brug.. von Martens, Mergui (67), p. 166.
1890 — — — O. Boettger (5), p. 165.
1891 — *auris felis* Br.. P. Fischer, Indo-Chine (22), p. 123 (reprint, p. 39).
1897 — *auris-felis* Brug.. von Martens (69), p. 141, pl. VIII, figs. 12—14.
1905 — — — Dautzenberg et H. Fischer, Tonkin (17), pp. 108—110.
1906 — — — Dautzenberg et H. Fischer, Indo-Chine (18), p. 377.
1914 — — Leschke, Java u. Celebes (58), p. 247.
1921 — — Brug.. Prashad, Sumatra (95), p. 467.

Coast near mouth of river Tji Lamaja, 2 specimens in excellent condition.

Coral-island Pulu Pandjang, 1 worn specimen. Mangrove-swamps at Tandjong Priok near Batavia (Strubell). Near Surabaya (von Martens).

Distribution: Sumatra: Benkulen; Deli, in mangrove-swamps and Serdang in mouth of river. Banka. Borneo. — Philippines, Tongking, Cambodia, Bangkok (Siam), Singapore, Mergui Archipelago (on mud-flats and in mangrove-swamps), Arakan (Burma).

119. **Auricula auris-judae** Linné sp..

1758 *Bulla Auris Judae.* Linné, Systema Naturae, edit. X, p. 728.
1767 *Voluta* — — Linné, Syst. Nat., edit. XII, p. 1187.
1773 *Auris Midae tridentata.* Martini, Conchylien-Cabinet, vol. II, pp. 119, 128, pl. XLIV, figs. 449—451.
1774 *Helix auris Judae.* O. Fr. Müller, Vermium terrestrium et fluviatilium seu animalium infusoriorum, helminthicorum, et testaceorum, non marinorum, Succincta Historia, vol. II, p. 109.

1789 *Bulimus auris Judae.* Bruguière, Encycl. méth. (10), vol. I, part 1, p. 344.
1791 *Voluta Auris Judae.* Gmelin, Syst. Nat. (27), p. 3437, nr. 10.
1822 *Auricula Judae.* Lamarck, An. s. vert. (52), vol. VI, 2 nd part, pp. 137—138, nr. 2.
1830 — — Lesson, Voyage autour du monde, exécuté sur la corvette de S. M. la Coquille; Zoologie, vol. II, p. 339.
1838 — — Lamarck, An. s. vert. (53), vol. VIII, pp. 324—325.
1838 — — L.. Potiez et Michaud, Galérie des Moll., I, p. 204.
1841 — — Lk.. Küster, Auriculacea (47), p. 15, pl. 3, figs. 1, 2.
1852 — — Souleyet, Voyage de la Bonite (20), vol. II, p. 515, pl. 29, figs. 19, 20.
1856 — *auris Judae* L.. Pfeiffer, Monogr. Auricul. (83), p. 130.
1876 — — — — Pfeiffer, Monogr. Pneum. viv.; Suppl. III, p. 357.
1878 — *Judae* Linn.. Sowerby in Reeve (97), vol. XX, Auricula, pl. III, figs. 16 a, b.
1887 — — — von Martens, Mergui (67), p. 166.
1889 — *dactylus* (*not* of Pfeiffer). L. Morlet in: Journal de Conchyliologie, vol. XXXVII, p. 129.
1891 — *auris Judae.* P. Fischer, Indo-Chine (22), p. 123 (reprint, p. 39).
— — *dactylus* (*not* of Pfeiffer). P. Fischer, ibid..
1891 — *aurisjudae* (L.). O. Boettger (6), p. 244.
1897 — *Judae* L.. von Martens (69), pp. 154—157, pl. VIII, figs. 6—11.
1902 — — — von Martens, Rumphius Gedenkb. (71), p. 123.
1906 — *auris Judae* Linné. Dautzenberg et H. Fischer, Indo-Chine (18), pp. 374—377.
1913 — *Judae* Linné. Schepman (104), p. 458.
1914 — *auris-judae.* Leschke, Java u. Celebes (58), p. 248.
1915 — *Judae* Lin.. Staub, Sangkulirangbai (107*bis*), pp. 124, 128.
1921 — *judae* (Linn.). Prashad, Sumatra (95), pp. 467—468.

Coast near mouth of river Tji Lamaja, 1 young specimen (worn).

Surabaya, shore of Bandjaran, 4 specimens.

Tandjong Priok near Batavia, in brackish water (Strubell).

Sumenep, isle of Madura (Collection Mousson).

Distribution: East Indian Archipelago (in brackish water, in mangrove-swamps, etc.): Sumatra (Palembang, Deli, Serdang), Riouw-archipelago, Banka, West coast of Borneo, Sangkulirangbay (E. Borneo), Southern Celebes, Togean Is. near Celebes, Lombok, Flores (in a brook near the coast), Timor, Amboina, Ceram, Buru, Bachan, Waigeu, Salawatti, Aru Is., New Guinea.

— N. W. coast of Western Australia, Northern Queensland.

— Philippines.

— Cochin-China, Siam, Singapore, Malacca, Pulo Penang, Salang-island, Mergui Archipelago, Irrawady Delta and Arakan (Burma), Andamans, Gangetic Delta, Vizagapatam (E. coast of India), Bombay.

Fossil in the Pliocene of E. Borneo (Sangkulirangbay).

120. **Melampus fasciatus** Deshayes sp..

1830 *Auricula fasciata*. Deshayes, Encyclopédie méthodique; Vers, vol. II, p. 90, nr. 8.

1832 — *monile* (*not* of Lamarck). Quoy et Gaimard, Voyage de l'Astrolabe (96), pp. 166—168, pl. 13, figs. 28—33.

1838 — *fasciata*. Deshayes in Lamarck, An. s. vert. (53), vol. VIII, p. 337, nr. 25.

1841 — *soricina*. Hombron et Jacquinot, Voyage au Pôle Sud; Moll., pl. 9, figs. 23—26.

1844 — *fasciata*. Küster, Auriculacea (47), p. 33, pl. 5, figs. 9—11.

1849 — — Desh.. Mousson, Java (79), pp. 46—47, pl. V, fig. 7.

1856 *Melampus fasciatus*. Pfeiffer, Monogr. Auricul. (83), p. 38.

1891 — — Desh.. O. Boettger (6), p. 278.

1897 — — — von Martens (69), pp. 161—163, pl. VIII, fig. 4.

1899 — — — Dautzenberg, Sumatra (15), p. 8.

1900 — — — E. A. Smith, Christmas Island (104d), p. 58, pl. VIII, fig. 17.

1907 *Melampus fasciatus* Pfeiffer. Couturier, Tahiti, etc. (13), p. 176.
1913 — — Desh.. Schepman (104), p. 458.
1914 — — Leschke, Java u. Celebes (58), pp. 248—249.

Mantjingan, south coast (Resid. Djocjakarta), 1 specimen, ground-colour yellowish with 5 chestnut bands.
Tjaringin (Resid. Bantam), coast of Sunda-strait (Zollinger).
Anjer, coast of Sunda-strait (von Martens).
Distribution: East Indian Archipelago: Near Indrapura (Sumatra), Flores, Timor (in a brackish lagoon), Amboina, Ceram, Tawalli-island N. of Bachan, Kei Is., New Guinea.
— New Ireland, Port Curtis (Queensland), New Caledonia, New Hebrides, Viti Is., Ellice Is., Samoa, Tahiti, Paumotu, Pitcairn-island, Jaluit (Marshall Is.), Pelew Is., Philippines, Lower Cochin-China, Salang-island (near Malay Peninsula), Nicobars, Andamans, Arakan (Burma), Bengal, Ceylon. — Christmas-island south of Java.
— Seychelles, Mauritius, Réunion, Mayotta (Comoro Is.).

FAM. **ZONITIDAE.**

121. **Dyakia rumphii** von dem Busch sp..

1842 *Helix Rumphii.* von dem Busch in Philippi, Abbildungen (86), vol. I, p. 9, Helix, pl. I, fig. 2.
1849 *Nanina Rumphii* v. d. Busch. Mousson, Java (79), p. 18, pl. I, fig. 2.
1852 *Helix* — Reeve (97), vol. VII, Helix, pl. LXXXVIII, fig. 480.
1867 *Nanina* — Busch sp.. von Martens, Ostasien Landschnecken (62), p. 220.
1886 *Nanina (Ariophanta) Rumphii.* Tryon (110), vol. II, p. 20, pl. 3, fig. 38.
1890 *Hemiplecta rumphii* (v. d. Busch). O. Boettger (5), p. 140.
1891 *Nanina (Hemiplecta) rumphi* (Busch). von Martens, Landschn. Ind. Arch. (68), pp. 229—230.
1912 *Dyakia Rumphii*, v. d. Busch. Schepman, Java (103), p. 231.
1914 — *rumphii.* Leschke, Java u. Celebes (58), p. 228.

Forest on the northwestern slope of the Malabar, south of Bandung (Resid. Preanger), 1 specimen.

This species is confined to Java: West Java (in forests): Near Buitenzorg (Zollinger, Teysmann), Gunung Salak (Strubell), Gunung Gedeh (Strubell, Jacobson), Tjibodas, S. E. of Buitenzorg (Weber), Sindanglaya near Tjibodas (von Martens), Gunung Megamendung N. of Gunung Gedeh (van Hasselt), Gunung Papandajan (von Martens).

Central Java: Gunung Ungaran, S. of Semarang (Jacobson).

122. **Hemiplecta umbilicaria** Le Guillou sp..

1842 *Helix umbilicaria*. Le Guillou in: Revue Zoologique, p. 137.

1849 *Nanina javanica* (*not* of Férussac). Mousson, Java (79), p. 15, pl. I, fig. 3.

1852 *Helix Javanica*. Reeve (97), vol. VII, Helix, pl. LXXVI, fig. 396.

1867 *Nanina umbilicaria* Guillou sp.. von Martens, Ostasien Landschn. (62), pp. 214—215.

1886 *Nanina (Xesta) umbilicaria* Le Guillou. Tryon (110), vol. II, p. 79, pl. 22, fig. 39.

1914 *Hemiplecta umbilicaria*. Leschke, Java u. Celebes (58), p. 227.

Teakwood at Penawangan, Resid. Semarang, 20 specimens.

Goendih, south of Poerwodadi, Resid. Semarang, 2 specimens.

Tjikoya, Resid. Bantam (Zollinger). Between Kediri and Modjokerto (von Martens). Wanasari, Tengger Mountains (Zollinger). Rogodjampi near Banjuwangi, E. Java (Zollinger). Pulu Rakata (Krakatau-island) in Sunda-strait (Zollinger).

Distribution: Sumatra, Banka.

123. **Hemiplecta densa** A. Adams et Reeve sp..

1850 *Helix densa*. A. Adams and Reeve, Zoology of the Voyage of the Samarang in the Eastern Seas; Mollusca, p. 62, pl. 16, fig. 8.

1850 *Helix Schumacheriana*. Pfeiffer in: Zeitschrift für Malakozoologie, 1850, p. 70.
1852 — *densa*. Reeve (97), vol. VII, pl. LXXIII, fig. 375.
— — *Schumacheriana*. Reeve, ibid., fig. 379.
1857 *Nanina corrosa*. Mousson in: Journal de Conchyliologie, vol. VI, p. 156.
1859 — *Herklotsiana*. Dohrn in: Malacozoologische Blätter, VI, p. 206.
1867 — *densa* Adams sp.. von Martens, Ostasien Landschn. (62), pp. 230—233, pl. 10, figs. 1, 2.
1886 *Nanina (Hemiplecta) Herklotsiana* Dohrn. Tryon (110), vol. II, p. 37, pl. 12, fig. 59.
— — — *densa*. Tryon, ibid., p. 42, pl. 14, figs. 91, 93.
— — — *Schumacheriana*. Tryon, ibid., p. 43, pl. 14, fig. 94.
1891 — *densa*. von Martens, Landschn. Ind. Arch. (68), p. 261.
1895 *Hemiplecta densa* Adams & Reeve. Schepman, Borneo-exped. (102), p. 150.
1900 *Nanina (Hemiplecta) densa* A. Ad. var. *atrofusca* Alb.. von Martens, Sumatra (70), p. 7.
1914 *Hemiplecta densa*. Leschke, Java u. Celebes (58), p. 226.

Forest on the northwestern slope of the Malabar, south of Bandung (Resid. Preanger), 1 specimen. The specimen is chestnut-coloured above and has one chestnut band below the obtuse carina.

Diam. maj. 47, diam. min. 37, altitude 27; apert., alt. 20, lat. 25 millimetres.

Buitenzorg (Zollinger). Near Adjibarang, Resid. Banjumas (F. Jagor).

Distribution: Sumatra, Borneo (in forests), Labuan-island near Borneo.

124. **Hemiplecta humphreysiana** Lea sp..

1841 *Helix Humphreysiana*. Lea in: Transactions of the American philosophical society of Philadelphia, VII, p. 463, pl. 12, fig. 16.

1852 *Helix gemina* (*non* v. d. Busch). Reeve (97), vol. VII, Helix, pl. LXXIII, fig. 374.
— — *nobilis*. Reeve, ibid., pl. LXXIV, fig. 381.
— — *Humphreysiana* Lea. Reeve, ibid., pl. LXXIV, fig. 387.
1867 *Nanina* — Lea sp.. von Martens, Ostasiatische Landschn. (62), pp. 233—235, pl. 10, figs. 3, 4, 6.
1886 — *(Hemiplecta) Humphreysiana*. Tryon (110), vol. II, p. 36, pl. 11, figs. 52, 53; pl. 12, fig. 54.
1890 *Hemiplecta humphreysiana* (Lea) var. *gemina* (*non* v. d. Busch). O. Boettger (5), pp. 139—140.
1891 — — — var. *complanata* Mts.. O. Boettger (6), p. 242.
1891 *Nanina humphreysiana*. von Martens, Landschn. Ind. Arch. (68), p. 261.
1900 — *(Hemiplecta) Humphreysiana* Lea. von Martens, Sumatra (70), p. 7.
1912 *Hemiplecta Humphreysiana*, Lea, var.. Schepman, Java (103), pp. 230—231.
1914 — *humphreysiana*. Leschke, Java u. Celebes (58), p. 226.

Goendih, south of Poerwodadi, Resid. Semarang, 1 specimen. As the shell is rather bleached, it is not possible to assign it with certainty to one of the forms distinguished by von Martens. In shape it agrees with var. *bifasciata* and var. *turbinata* of von Martens. Diam. maj. $39^1/_2$, diam. min. 33, altitude 28 millimetres.

Buitenzorg, Botanical Gardens (Teysmann). Gunung Salak (Strubell). Sindanglaya, S. E. of Buitenzorg (von Martens). Near Adjibarang, Resid. Banjumas (F. Jagor). Nusa-Kambangan-island near south coast (Jacobson).

Distribution: Sumatra, Batu Is. W. of Sumatra, Singapore, Johore (Malay Peninsula).

FAM. **HELICIDAE.**

125. **Plectotropis ciliocincta** von Möllendorff.

1897 *Plectotropis ciliocincta*. von Möllendorff, Neue Landschn. v. Java (78), pp. 67—68.

1914 *Plectotropis ciliocincta*. Leschke, Java u. Celebes (58), p. 235.

Goendih, south of Poerwodadi, Resid. Semarang, 20 specimens.

I owe the identification of the specimens to Miss W. S. S. van Benthem Jutting of the Zoological Museum at Amsterdam.

126. **Trochomorpha bicolor** von Martens.

1864 *Trochomorpha bicolor*. von Martens in: Monatsberichte der Königl. Akademie der Wissenschaften zu Berlin, p. 267.
1867 — — von Martens, Ostasien Landschn. (62), pp. 252—253, pl. 13, fig. 2.
1887 *Helix (Videna) bicolor* Martens. Tryon (110), vol. III, p. 82, pl. 16, figs. 83—85.
1895 *Trochomorpha bicolor* Martens. Schepman, Borneo-exped. (102), p. 155.
1914 — — Leschke, Java u. Celebes (58), p. 230.

Not *Trochomorpha bicolor* L. Morlet (Journ. de Conchyl., vol. XXXIII, p. 259, 1886); Mabille (Bull. Soc. Mal. Fr., 1887, p. 98); P. Fischer (Indo-Chine (22), p. 108 (reprint, p. 24)) = *Tr. sapeca* Heude sp..

Penawangan, Resid. Semarang, 5 specimens.
Wanasari, Tengger Mountains, E. Java (Zollinger).
Distribution: Sumatra, Borneo.

127. **Amphidromus palaceus** (von dem Busch M. S.) Mousson sp..

1849 *Bulimus palaceus* v. d. Busch. Mousson, Java (79), pp. 28, 108, pl. III, fig. 1.
1867 *Bulimus (Amphidromus) palaceus* Busch. von Martens, Ostasien Landschn. (62), p. 352 (exclusive of synon. *Bulimus mundus*).
1900 *Amphidromus palaceus*. Pilsbry (110), vol. XIII, p. 134, pl. 47, figs. 1, 2, 4—6.
1912 — — Schepman, Land- a. freshw. Moll. Java (103), p. 234.

1914 *Amphidromus palaceus*. Leschke, Java u. Celebes (58), p. 233.

Coast near Government Rubber Estate Balong, N.E. of Japara (Resid. Semarang), 1 bleached specimen (sinister).

This species is confined to Java: Pardana (Pĕrdana) and Tjikoya in the Residency Bantam in coffee plantations (Zollinger). Palabuan at the Wijnkoopsbay (von Martens). Babakan (? near Tjiandjur, Preanger) (Jacobson).

128. **Amphidromus winteri** Pfeiffer sp..

1849 *Bulimus Winteri*. Pfeiffer in: Zeitschrift für Malakozoologie, 1849, p. 135.

1867 *Bulimus (Amphidromus) Winteri* Pfr.. von Martens, Ostasien Landschn.(62), pp. 353—355.

1900 *Amphidromus Winteri*. Pilsbry (110), vol. XIII, p. 137, pl. 48, figs. 13, 14, 15.

1914 — *winteri*. Leschke, Java u. Celebes (58), p. 234.

Goendih, south of Poerwodadi, Resid. Semarang, 1 specimen.

Teakwood near Bandjarredjo, Resid. Rembang, 1 specimen.

The specimen from Goendih is pale rufous, that from Bandjarredjo is entirely bleached. Both shells are dextral.

This species is confined to Java: Tjisurupan, Preanger, in coffee plantations (von Martens). Bandjar, Resid. Banjumas (F. Jagor).

Forma **robusta** Fulton.

1867 *Bulimus Winteri*, gebändertes Exemplar. von Martens, Ostasien Landschn. (62), p. 354, pl. 20, fig. 4.

1896 *Amphidromus robustus*. Fulton, List of species of Amphidromus (26), p. 73.

1900 — *heerianus* (Mousson) Pfr., var. *robustus* Fulton. Pilsbry (110), vol. XIII, p. 139, pl. 46, fig. 21.

1914 *Amphidromus heerianus*, v. *robustus*. Leschke, Java u. Celebes (58), p. 232.

Forest on the northwestern slope of the Malabar, south of Bandung (Resid. Preanger), 1 specimen. The specimen differs from Fulton's description in being dextral and perforate. The reddish spiral bands are not upon a white, but upon a pale yellowish ground.

Height: 53 mill.; maximum diameter: 30 millimetres.

This form was hitherto only recorded from Bandjar, Residency Banjumas (von Martens).

129. **Amphidromus alticola** (Boettger M.S.S.) Fulton.

1896 *Amphidromus alticola* (Boettger M.S.S.). Fulton, List of Amphidromus (26), p. 70, pl. 6, figs. 5, 5 a.

1900 — — Pilsbry (110), vol. XIII, p. 147, pl. 53, figs. 75, 76.

1914 — *albicola*. Leschke, Java u. Celebes (58), p. 231.

Forest on the northwestern slope of the Malabar, south of Bandung (Resid. Preanger), 1 specimen.

Confined to Java.

130. **Amphidromus perversus rufocinctus** Fruhstorfer.

1905 *Amphidromus perversus rufocinctus*. H. Fruhstorfer, Bawean und Engano (25), pp. 199—200.

There are 3 specimens of this characteristic subspecies, described from Bawean by Fruhstorfer. Unfortunately their exact locality is not known, it may be either Bawean-island, or the Karimon-Djawa-islands, both north of Java in the Java Sea.

131. **Amphidromus (Syndromus) porcellanus** Mousson sp..

1849 *Bulimus porcellanus*. Mousson, Java (79), pp. 33—34. 110—111, pl. III, fig. 4.

1867 *Bulimus (Amphidromus) porcellanus* Mouss.. von Martens, Ostasien Landschn. (62), pp. 365—366.
1890 *Amphidromus porcellanus* (Mouss.). O. Boettger (5), p. 146.
1891 — — — von Martens, Landschn. Ind. Arch. (68), p. 241.
1900 — *(Syndromus) porcellanus*. Pilsbry (110), vol. XIII, p. 201, pl. 64, figs. 5—7.
1914 — — — Leschke, Java u. Celebes (58), pp. 213, 233—234.

Forest on the northwestern slope of the Malabar, south of Bandung (Resid. Preanger), 2 specimens. Buitenzorg, Botanical Gardens (Strubell; Kraepelin). Distribution: Deli, Sumatra.

132. **Amphidromus (Syndromus) furcillatus** Mousson sp..

1848 *Bulimus laevus* (in part). Reeve (97), vol. V, Bulimus, pl. XXXVII, fig. 216 a.
1849 — *elegans* (*non* Pfeiffer). Mousson, Java (79), pp. 32—33, 110, pl. III, fig. 3.
— — *furcillatus*. Mousson, ibid., p. 115.
1867 — *(Amphidromus) furcillatus* Mouss.. von Martens, Ostasien Landschn. (62), pp. 357—358, pl. 21, fig. 3.
1896 *Amphidromus furcillatus*. Fulton, Amphidromus (26), p. 76.
1900 *Amphidromus (Syndromus) furcillatus*. Pilsbry (110), vol. XIII, p. 216, pl. 66, figs. 38—40.
1912 — *furcillatus*, Mousson. Schepman, Java (103), p. 234.
1914 — — Leschke, Java u. Celebes (58), p. 232.

Goendih, south of Poerwodadi, Resid. Semarang, 6 specimens.

Teakwood at Penawangan, Resid. Semarang, 4 specimens.

One specimen has the flammules but rarely bifurcated.

Another shell from Penawangan has a somewhat deviating appearance, the flammules being very regularly interrupted on the periphery. On the upper half of the whorl there are often more than three branches corresponding to one square spot or flame on the lower half of the whorl. The fine specimen has a pink margin below the suture and two basal spiral bands. The buff ground colour of the last whorl is marked with numerous grass-green lines [1]).

Nongkodjadjar, Tengger Mountains (Jacobson). Gunung Lamongan, Resid. Pasuruan (F. Jagor). Balung, S. W. of Djember, Resid. Besuki (Semmelink). Litjin and Rogodjampi near Banjuwangi (Zollinger).

Distribution: Bali.

FAM. **BULIMINIDAE.**

133. **Buliminus** (**Coccoderma**) **glandula** Mousson sp..

1849 *Bulimus glandula*. Mousson, Java (79), pp. 34—35, pl. IV, fig. 3.

1867 *Buliminus* (*Napaeus*) *glandula* Mouss. sp.. von Martens, Ostasien Landschn. (62), p. 370.

1891 — — — von Martens, Landschn. Ind. Arch. (68), p. 255.

1914 — *(Coccoderma)* — Leschke, Java u. Celebes (58), p. 236.

Penawangan, Resid. Semarang, 1 specimen.

Altitude 18, diam. maj. $7^1/_2$ millimetres.

Southern Java, on shrubs (Zollinger). Sumenep, isle of Madura (Zollinger).

The species seems to be confined to Java and Madura.

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1) Possibly this deviating specimen does not belong to *Amphidromus furcillatus*, but to a new species.

FAM. **LYMNAEIDAE.**

134. **Lymnaea javanica** Mousson.

1849 *Limnaeus succineus* var. *javanica*. Mousson, Java (79), pp. 42—43, pl. V, fig. 1.
1872 *Limnaea Javanica*. Sowerby in Reeve (97), vol. XVIII, Limnaea, pl. VIII, fig. 50.
1897 — *javanica* Mouss.. von Martens, Süss- u. Brackw. Moll. Ind. Arch. (69), pp. 3—6, pl. 1, figs. 3—7.
1898 — — — P. u. F. Sarasin, Süssw. moll. Celebes (101), pp. 88—89.
1913 — — — Schepman, Siboga exp. (104), p. 459.
1921 — — (Mouss.). Prashad, Sumatra (95), pp. 469—471.
1922 *Lymnaea* — Mouss.. Van Heurn en Paravicini, Gajolanden (29), p. 29, fig. 6.

This variable species is represented in the collection by only one form:

Forma **obesa** von Martens.

1867 *Limnaeus javanicus* Hasselt, var. *obesus*. von Martens, Ostasiat. Limnaeaceen (61), p. 223.
1881 *Limnaea Javanica* Hasselt, var. *obesa*. von Martens in: Conchologische Mittheilungen als Fortsetzung der Novitates conchologicae, vol. I, p. 87, pl. 16, fig. 1.
1914 *Lymnaea javanica*, v. *obesa*. Leschke, Java u. Celebes (58), p. 250.

Coast near mouth of river Tji Lamaja, 7 specimens. The form *obesa* was originally mentioned from Telaga Patengan, S. W. of Bandung (Resid. Preanger).

Distribution of *Lymnaea javanica*: East Indian Archipelago: Sumatra, Banka, Borneo, Celebes, Java, Bali to Flores, Sumba, Rotti, Timor.

SCAPHOPODA.

FAM. DENTALIIDAE.

135. **Dentalium (Laevidentalium) eburneum** Linné.

1767	*Dentalium eburneum.*		Linné, Systema Naturae, edit. XII, p. 1264.
1818	—	—	Lamarck, An. s. vert. (52), vol. V, p. 346.
1838	—	—	Lamarck, An. s. vert. (53), vol. V, p. 598.
1860	—	—	Sowerby, Thesaurus (106), vol. III, p. 98, pl. 225, fig. 53.
—	—	*Philippinarum.*	Sowerby, ibid., fig. 54.
1872	—	*eburneum.*	Sowerby in Reeve (97), vol. XVIII, Dentalium, pl. III, fig. 16.
—	—	*Philippinarum.*	Sowerby, ibid., fig. 18.
1897	—	*eburneum.*	Pilsbry & Sharp (109), vol. XVII, p. 115, pl. 20, figs. 33, 34.
1906	—	*(Laevidentalium) eburneum.*	Boissevain (7), p. 52, pl. II, fig. 31; pl. IV, figs. 10, 11.
1920	—	— —	Tesch, Timor (108), II, p. 85, pl. CXXXIV, fig. 232.

Coast near mouth of river Tji Lamaja, 1 specimen. Off Djangkar, N. coast of Resid. Besuki, E. Java (Siboga exped.).

Distribution: East Indian Archipelago: Timor, Timor Sea, Ceram.

— Philippines, Siam, Singapore.

Fossil in the Pliocene of Timor.

Besides the only specimen of *Dent. eburneum* there are 5 specimens of longitudinally ribbed Dentaliidae belonging to the subgenus *Dentalium s. str.* from the same locality (Tji Lamaja). The specimens are eight- and nine-ribbed. I could not determine them with certainty.

ADDENDA ET CORRIGENDA.

Page 8, line 15 from top, for Linn.. read Lin..

2. **Acmaea saccharina** L. sp..

Add to Synonymy:

1855 *Patella saccharina.* Hanley, Ipsa Linnaei Conchylia, pp. 418, 545.

1885 — — (Linne). Boog Watson, Challenger Gasterop. (8), pp. 29—30.

Page 12:

8. **Turbo (Senectus) ticaonicus** Rve..

Add to Synonymy:

1915 *Turbo Ficaonicus* (p. err.) Rve.. Staub, Sangkulirangbai (107*bis*), p. 126.

Add to Distribution: Sangkulirang-bay (E. Borneo).

Page 12, line 3 from bottom, for 1886 read 1885.

Page 13:

9. **Trochus (s. str.) niloticus** L..

Add to Synonymy:

1915 *Trochus niloticus* Lin.. Staub, Sangkulirangbai (107*bis*), pp. 124, 130.

Add to Distribution: Sangkulirang-bay (E. Borneo).

Page 14, line 7 from top, for 1788–'90 read 1791.

Page 17, line 2 from top, for 1788–'90 read 1791; erase line 1 from bottom.

Page 18, line 5 from top, for 1788–'90 read 1791; delete L. after the word *Labio*;
line 12 from bottom, for 1886 read 1885.

Page 19, line 15 from bottom, for 1788–'90 *Turbo Nicobaricus* read 1791 *Turbo nicobaricus.*

15. **Chrysostoma paradoxum** Born sp..

Add to Synonymy:

1854 *Chrysostoma paradoxum*. H. and A. Adams, The Genera of Recent Mollusca arranged according to their organization, vol. I, p. 410, pl. XLVI, fig. 4.

Page 20, line 3 from top, for 1886 read 1885.

Page 21, line 19 from top, for 1788–'90 *Nerita albicilla* read 1791 *Nerita Albicilla*, and after p. 3681, add nr. 45.
Line 20 from top, read *albicilla*.

17. **Nerita (Theliostyla) albicilla** L..

Add to Synonymy:

1886 *Nerita albicilla*, Linne. Boog Watson, Challenger Gasterop. (8), pp. 678—679.

Page 24, line 11 from top, for 1788–'90 read 1791.

Page 25:

19. **Nerita (Theliostyla) chamaeleon** L..

Add to Synonymy:

1886 *Nerita chamaeleon*, Linne. Boog Watson, Challenger Gasterop. (8), p. 679.

Page 29, line 10 from top, for 1788–'90 read 1791.

Page 30, lines 9 and 8 from bottom, for 1788–'90 read 1791, and for nr. 26 read nr. 66.
Line 7 from bottom, for *larva* read *Larva*, and after p. 3679, add nr. 38.
Line 6 from bottom, after p. 3685, add nr. 67.

Page 40:

26. **Turritella (s. str.) terebra** L. sp..

Add to Synonymy:

1915 *Turritella terebra* Lin.. Staub, Sangkulirangbai (107*bis*), p. 126.

Add to Distribution: Sangkulirang-bay (E. Borneo), empty shells abundant on the shore.

Page 45, lines 7 and 8 from top, for 1788–'90 *Helix acicula* read 1791 *Helix Acicula*, and after p. 3668, add nr. 222.

Page 51, line 12 from bottom, for 1886 read 1885.

Page 66:

48. **Natica (s. str.) maculosa** Lamarck.

Add to Synonymy:

1915 *Natica maculata* (sic!) Lk. oder *javanica* Lk.. Staub, Sangkulirangbai (107*bis*), p. 125.

Add to Distribution: Sangkulirang-bay (E. Borneo), on mud-flats; Balikpapan (E. Borneo).

Page 67, line 17 from bottom, for 1886 read 1885.
Page 69, line 4 from top, for 1886 read 1885.

50. **Natica (Polinices) mamilla** L. sp..

Add to Synonymy:

1915 *Natica mamilla* Lin.. Staub, Sangkulirangbai (107*bis*), p. 125.

— *pyriformis* Recl.. Staub, ibid., p. 125.

Add to Distribution: Sangkulirang-bay (E. Borneo).

Page 76:

54. **Potamides (Telescopium) telescopium** L. sp..

Add to Synonymy:

1915 *Telescopium telescopium* Brug.. Staub (107*bis*), pp. 124, 128.

Add to Distribution: Numerous in the estuaries of East Borneo.

Fossil in the Pliocene of E. Borneo (Sangkulirang-bay).

Page 77, line 8 from bottom, for *lambis* read *Lambis*.

Page 78:

56. **Pterocera lambis** L. sp..

Add to Synonymy:

1915 *Pterocera lambis* Lin.. Staub (107*bis*), p. 133.

Add to Distribution: On coralreefs near the Sangkulirang-bay (E. Borneo).

Page 80:

58. **Pterocera (Harpago) chiragra** L. sp..

Add to Synonymy:

1915 *Pterocera Chiragra* Lin.. Staub (107*bis*), p. 133.

Add to Distribution: On coralreefs near the Sangkulirang-bay (E. Borneo).

Page 80, line 19 from top, for *canarium* read *Canarium*.
Line 21 from top, read *canarium*.
Page 81, line 13 from top, for 1886 read 1885.

59. **Strombus canarium** L..

Add to Synonymy:
1915 *Strombus isabella* Lk.. Staub (107*bis*), pp. 126, 133.
Add to Distribution: East Borneo: Balikpapan; near the Sangkulirang-bay (on coralreefs).

Pages 83—84:

61. **Strombus (Canarium) muricatus** Martini.

Add to Synonymy:
1825 *Strombus urceus* (*not* of Linné). Wood, Index Testaceologicus, pl. 25, fig. 32.
1832 — — (*not* of Linné). Deshayes, Encyclopédie Méthodique, vol. III, p. 993, sp. 15.
1907 — — (*not* of Linné). Couturier, Tahiti, etc. (13), p. 153.
Add to Distribution: Paumotu.

Page 84, line 10 from top, for 1886 read 1885.
Page 86, line 14 from top, for *carneola* read *Carneola*.
Page 91, line 5 from bottom, for *caput serpentis* read *Caput serpentis*.
Page 94, line 1 from top, for Linn.. read Lin..
Page 98, line 6 from top, after p. 573, add nr. 194.

Page 99:

71. **Cypraea (Luponia) lynx** L..

Add to Synonymy:
1885 *Cypraea lynx*, Linne. Boog Watson, Challenger Gasterop. (8), p. 423.
1915 - *Lynx* Lin.. Staub, Sangkulirangbai (107*bis*), p. 133.
Add to Distribution: On coralreefs near the Sangkulirang-bay (E. Borneo).

Page 105:

74. **Cypraea (Luponia) erosa** L..

Add to Synonymy:

1915 *Cypraea erosa* Lin.. Staub (107*bis*), p. 133.

Add to Distribution: On coralreefs near the Sangkulirang-bay (E. Borneo).

Page 107:

76. **Cassis cornuta** L. sp..

Add to Synonymy:

1791 *Buccinum cornutum*. Gmelin, Syst. Nat. (27), pp. 3472—3473, nr. 11.

1795 *Cassis labiata*. Chemnitz, Neues systematisches Conchylien-Cabinet, vol. XI, p. 71, pls. 184, 185.

1832 *Cassis cornuta*. Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. II, pp. 590—592, pl. 43, figs. 1—6.

1835 — — Kiener (32), vol. VIII, Cassis, p. 9, nr. 4, pl. 2, fig. 3.

1915 — — Lin.. Staub, Sangkulirangbai (107*bis*), pp. 125, 132.

Add to Distribution: On coralreefs in the Sangkulirang-bay (E. Borneo).

Page 108:

77. **Cassis (Bezoardica) decussata** L. sp..

Add to Synonymy:

1857 *Cassis decussata* Linné. Küster (43), pp. 9—10, pl. 38, figs. 1, 2, 8, 9.

Page 111, line 20 from top, for *Murex (Tribulus) ternispina* read *Murex (s.str.) ternispina*, pars.

82. **Murex martinianus** Rve..

Add to Synonymy:

1915 *Murex Martinianus* Rve.. Staub, Sangkulirangbai (107*bis*), pp. 125, 130.

Add to Distribution: E. Borneo: Shore of Klandasan near Balikpapan; near mouth of river Sambodja; Sangkulirang-bay (on a sandy beach, numerous on mud-flats).

Page 119:

92. **Fasciolaria trapezium** L. sp..

Add to Synonymy:

1832 *Fusus trapezium*. Quoy et Gaimard, Voyage de l'Astrolabe (96), vol. II, pp. 511—512.

1855 *Murex trapezium*. Hanley, Ipsa Linnaei Conchylia, pp. 306, 525.

1885 *Fasciolaria trapezium* (Linne). Boog Watson, Challenger Gasterop. (8), pp. 241—242.

1915 *Fasciolum* (p. err.) *trapezium* Lin.. Staub, Sangkulirangbai (107*bis*), p. 133.

Add to Distribution: On coralreefs near the Sangkulirang-bay (E. Borneo).

— Nicobars, Ceylon.

Page 119, line 19 from bottom, for fig. 26 read figs. 24—26.

Line 17 from bottom, for fig. 22 read figs. 21—23.

Page 121, line 20 from top, for p. 1494 read p. 1194, nr. 428.

Page 122:

95. **Voluta (Vespertilio) vespertilio** L..

Add to Synonymy:

1885 *Voluta (Vespertilio) vespertilio*, Linne, var. *pellis serpentis*, Lamarck. Boog Watson, Challenger Gasterop. (8), p. 254.

1915 *Voluta vespertilio* Lin.. Staub, Sangkulirangbai (107*bis*), p. 126.

Add to Distribution: Sangkulirang-bay (E. Borneo), on mud-flats exposed at low tide.

Page 138:

112. **Bulla ampulla** L..

Add to Synonymy:

1886 *Bulla ampulla*, Linne. Boog Watson, Challenger Gasterop. (8), p. 637.

1915 — — Lin.. Staub, Sangkulirangbai (107*bis*), p. 125.

Add to Distribution: Sangkulirang-bay (E. Borneo), on mud-flats.

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EXPLANATION OF FIGURES.

EXPLANATION OF FIGURES.

Except when otherwise marked, the figures are of natural size.

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Fig. 1

Fig. 2

Fig. 3a (× 2⅓)

3b (× 2⅓)

3c (× 2⅓)

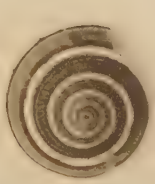


Fig. 4

Fig. 5a (× 2⅓)

5b (× 2⅓)

5c (× 2⅓)

ig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13 Fig. 14

Fig. 15a 15b

DIE VERSCHIEBUNG GENOTYPISCHER VERHÄLTNISZAHLEN INNERHALB POPULATIONEN LAUT MATHEMATISCHER BERECHNUNG UND EXPERIMENTELLER PRÜFUNG

VON

DR. M. J. SIRKS.

Das Problem der Verschiebung der genotypischen Verhältnisse in Populationen, welche einer Mendelspaltung ihre Entstehung verdanken, ist bis jetzt nur von mathematischer Seite angegriffen worden. Diese Aenderung der Zahlenverhältnisse, in welchen die in der Nachkommenschaft der ursprünglichen F_1-Generation vorhandenen Genotypen auftreten, ist selbstverständlich von mehreren Umständen abhängig: entweder kann *a*) die Population spontan ändern, dank der Anwesenheit homozygotischer neben heterozygotischen Individuen, dazu noch kompliziert durch Unterschiede in Fruchtbarkeit, geringere genotypisch-veranlagte Lebensfähigkeit bestimmter Gametenkombinationen, durch Unterbleiben bestimmter Kombinationen (Prohibition im Sinne HERIBERT-NILSSONS) und nachfolgende Substitution, und schliesslich durch die Zertation, schnelleres Wachstum bestimmt veranlagter Pollenschläuche unter verschiedenen Temperaturverhältnissen, oder auch kann *b*) künstlich durch Selektion in diese fortwährende Aenderung eingegriffen werden. Ausserdem haben die Unterschiede in Befruchtungsart: 1) Selbstbefruchtung, 2) Autogamie neben Allogamie in wechselnden Frequenzen und 3) vollkommene Panmixie einen verschiedenen Verlauf der Populationsänderungen zufolge.

Die in dieser Arbeit zusammengetragenen Betrachtungen und Untersuchungen beziehen sich auf vier ziemlich einfache Fälle:

a. Monohybride Bastardierung und die Nachkommenschaft der F_1-Generation ohne etwaige Selektion;

b. Monohybride Bastardierung und ihre Nachkommenschaft

unter fortwährender Selektion des dominanten A-typus und Vernichtung der ausspaltenden rezessiven a-Individuen;

c. Dihybride Bastardierung und die Nachkommenschaft ohne Selektion;

d. Dihybride Bastardierung und ihre Nachkommen mit andauernder Auswahl der Doppeldominanten, also AB-Pflanzen, während sämtliche ausspaltenden Ab-, aB- und ab-Individuen beseitigt wurden.

Der Zwecke der Arbeit waren drei: erstens die diesbezüglichen, zum Teil schon von anderen Autoren veröffentlichten, mathematischen Betrachtungen als ein Ganzes zusammenzustellen und ihre Lücken zu ergänzen; zweitens die Genauigkeit der mathematischen Theorie zu prüfen in einer Reihe darauf gerichteter Kulturen mit Rassen, deren hochgradige Selbstbefruchtung (Erbsen) und deren starke panmictische Vermehrung (Mays) schon bekannt war und drittens habe ich versucht mit Hilfe der mathematischen Ergebnisse an Pflanzen, deren Grad von Selbstbefruchtung nicht genau bekannt war, diesen Grad zu bestimmen.

Speziell in diezer Richtung angestellte Versuche sind mir fast nicht bekannt; nur Heribert-Nilsson (1921) hat m.W. in einer kleineren Arbeit die Verschiebung einer Roggenpopulation behandelt, welche einer monohybriden Bastardierung ihre Entstehung verdankte.

Der obengenannten Einteilung gemäss, fällt diese Arbeit in vier Abschnitte auseinander, welche gesondert dargestellt werden.

* * *

a. Monohybride Bastardierung und die Nachkommenschaft der F_1-Generation ohne etwaige Selektion.

Nachdem Pearson (1904), Hardy (1908), Jennings, (1912, 1916) u. A., für den hier behandelten Verlauf in einzelnen Fällen mathematische Formeln gegeben hatten, ist Heukels (1915) als Erster zur Darstellung einer allgemein-gültigen Formel gelangt, welche die Homozygotenzahl jeder beliebigen Generation unter jedem Verhältnis der Selbstbefruchtungs- und Kreuzbefruchtungsfrequenzen berechnen lässt. Heukels hat die Frequenz der Selbstbefruchtung x, diejenige der Fremdbefruchtung y genannt, und gibt sodann für die Totalzahl der Homozygoten die Formel (1915. S. 302):

$$\text{Hom.} = \frac{x + y}{x + 2y} - \frac{x + y}{x + 2y}\left\{\frac{x}{2(x + y)}\right\}^n$$

Dabei soll aber berücksichtigt werden, dass seine Betrachtungen von einer schon heterogenen F_1-Generation ausgegangen sind, seine F_1-Generation also unsere F_2 ist, und seine n für die allgemeine n-te-Generation deshalb als n-1 geschrieben werden soll. Die drei genotypischen Gruppen: A A, Aa, aa haben sodann, in dieser Weise geändert, die nachfolgenden Frequenzen:

$$AA = aa = \frac{x + y}{2(x + 2y)} - \frac{x + y}{2(x + 2y)} \left\{ \frac{x}{2(x + y)} \right\}^{n-1}$$

$$Aa = \frac{y}{x + 2y} + \frac{x + y}{x + 2y} \left\{ \frac{x}{2(x + y)} \right\}^{n-1}$$

Mit Hilfe dieser ziemlich einfachen Formeln kann nun der mathematisch erwartete Verlauf einer jeden aus monohybrider Mendelspaltung hervorgegangenen und als ein Ganzes gezüchteten Population berechnet werden, wie die nachfolgenden tabellarisch verfassten Ergebnisse zeigen; (die y-Zahl gibt das Prozent der Fremdbefruchtungen an):

TABELLE I. MONOHYBRIDE OHNE SELEKTION
Y % FREMDBEFRUCHTUNGEN.

	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 100 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	25.0	50.0	25.0	75.0	25.0
F_4	25.0	50.0	25.0	75.0	25.0
F_5	25.0	50.0	35.0	75.0	25.0
F_6	25.0	50.0	25.0	75.0	25.0
F_7	25.0	50.0	25.0	75.0	25.0
$F\infty$	25.0	50.0	25.0	75.0	25.0
y = 95 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	25.62	48.76	25.62	74.38	25.62
F_4	25.64	48.72	25.64	74.36	25.64
F_5	25.64	48.72	25.64	74.36	25.64
F_6	25.64	48.72	25.64	74.36	25.64
F_7	25.64	48.72	25.64	74.36	25.64
$F\infty$	25.64	48.72	25.64	74.36	25.64

	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 90 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	26.25	47.50	26.25	73.75	26.25
F_4	26.31	47.38	26.31	73.69	26.31
F_5	26.31	47.38	26.31	73.69	26.31
F_6	26.31	47.38	26.31	73.69	26.31
F_7	26.31	47.38	26.31	73.69	26.31
$F\infty$	26.31	47.38	26.31	73.69	26.31
y = 85 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	26.87	46.26	26.87	73.13	26.87
F_4	27.01	45.98	27.01	72.99	27.01
F_5	27.02	45.96	27.02	72.98	27.02
F_6	27.02	45.96	27.02	72.98	27.02
F_7	27.02	45.96	27.02	72.98	27.02
$F\infty$	27.02	45.96	27.02	72.98	27.02
y = 80 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	27.50	45.0	27.50	72.50	27.50
F_4	27.75	44.50	27.75	72.25	27.75
F_5	27.78	44.44	27.78	72.22	27.78
F_6	27.78	44.44	27.78	72.22	27.78
F_7	27.78	44.44	27.78	72.22	27.78
$F\infty$	27.78	44.44	27.78	72.22	27.78
y = 75 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	28.13	43.74	28.13	71.87	28.13
F_4	28.52	42.96	28.52	71.48	28.52
F_5	28.57	42.86	28.57	71.43	28.57
F_6	28.57	42.86	28.57	71.43	28.57
F_7	28.57	42.86	28.57	71.43	28.57
$F\infty$	28.57	42.86	28.57	71.43	28.57
y = 70 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	28.75	42.50	28.75	71.25	28.75
F_4	29.31	41.38	29.31	70.69	29.31
F_5	29.40	41.20	29.40	70.60	29.40
F_6	29.41	41.18	29.41	70.59	29.41
F_7	29.41	41.18	29.41	70.59	29.41
$F\infty$	29.41	41.18	29.41	70.59	29.41

	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 65 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	29.38	41.24	29.38	70.62	29.38
F_4	30.14	39.72	30.14	69.86	30.14
F_5	30.27	39.46	30.27	69.73	30.27
F_6	30.30	39.40	30.30	69.70	30.30
F_7	30.30	39.40	30.30	69.70	30.30
$F\infty$	30.30	39.40	30.30	69.70	30.30
y = 60 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	30.0	40.0	30.0	70.0	30.0
F_4	31.0	38.0	31.0	69.0	31.0
F_5	31.20	37.60	31.20	68.80	31.20
F_6	31.24	37.52	31.24	68.76	31.24
F_7	31.25	37.50	31.25	68.75	31.25
$F\infty$	31.25	37.50	31.25	68.75	31.25
y = 55 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	30.63	38.74	30.63	69.37	30.63
F_4	31.89	36.22	31.89	68.11	31.89
F_5	32.17	35.66	32.17	67.63	32.17
F_6	32.24	35.52	32.24	67.76	32.24
F_7	32.26	35.48	32.26	67.74	32.26
$F\infty$	32.26	35.48	32.26	67.74	32.26
y = 50 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	31.25	37.50	31.25	68.75	31.25
F_4	32.81	34.38	32.81	67.19	32.81
F_5	33.20	33.60	33.20	66.80	33.20
F_6	33.30	33.40	33.30	66.70	33.30
F_7	33.33	33.34	33.33	66.67	33.33
$F\infty$	33.33	33.33	33.33	66.66	33.33
y = 45 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	31.88	36.24	31.88	68.12	31.88
F_4	33.77	32.46	33.77	66.23	33.77
F_5	34.29	31.42	34.29	65.71	34.29
F_6	34.43	31.14	34.43	65.57	34.43
F_7	34.47	31.06	34.47	65.53	34.47
$F\infty$	34.48	31.04	34.48	65.52	34.48

	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 40 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	32.50	35.0	32.50	67.50	32.50
F_4	34.75	30.50	34.75	65.25	34.75
F_5	35.43	29.14	35.43	64.57	35.43
F_6	35.63	28.74	35.63	64.37	35.63
F_7	35.69	28.62	35.69	64.31	35.69
$F\infty$	35.71	28.58	35.71	64.29	35.71
y = 35 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	33.13	33.74	33.13	66.87	33.13
F_4	35.77	28.46	35.77	64.23	35.77
F_5	36.64	26.74	36.64	63.36	36.64
F_6	36.91	26.18	36.91	63.09	36.91
F_7	37.0	26.0	37.0	63.0	37.0
$F\infty$	37.04	25.92	37.04	62.96	37.04
y = 30 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	33.75	32.50	33.75	66.25	33.75
F_4	36.81	26.38	36.81	63.19	36.81
F_5	37.88	24.24	37.88	62.12	37.88
F_6	38.25	23.50	38.25	61.75	38.25
F_7	38.37	23.26	38.37	61.63	38.37
$F\infty$	38.46	23.08	38.46	61.54	38.46
y = 25 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	34.38	31.24	34.38	65.62	34.38
F_4	37.88	24.24	37.88	62.12	37.88
F_5	39.19	21.62	39.19	60.81	39.19
F_6	39.63	20.74	39.63	60.37	39.63
F_7	39.86	20.28	39.86	60.14	39.86
$F\infty$	40.0	20.0	40.0	60.0	40.0
y = 20 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	35.0	30.0	35.0	65.0	35.0
F_4	39.0	22.0	39.0	61.0	39.0
F_5	40.6	18.8	40.6	59.4	40.6
F_6	41.24	17.52	41.24	58.76	41.24
F_7	41.50	17.0	41.50	58.50	41.50
$F\infty$	41.66	16.68	41.66	58.34	41.66

	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 15 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	35.63	28.74	35.63	64.37	35.63
F_4	40.14	19.72	40.14	59.86	40.14
F_5	42.06	15.88	42.06	57.94	42.06
F_6	42.83	14.34	42.83	57.17	42.83
F_7	43.23	13.54	43.23	56.77	43.23
$F\infty$	43.48	13.04	43.48	56.52	43.48
y = 10 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	36.25	27.5	36.25	63.75	36.25
F_4	41.31	17.38	41.31	58.69	41.31
F_5	43.59	12.82	43.59	56.41	43.59
F_6	44.62	10.76	44.62	55.38	44.62
F_7	45.08	9.84	45.08	54.92	45.08
$F\infty$	45.45	9.1	45.45	54.55	45.45
y = 9 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	36.38	27.24	36.38	63.62	36.38
F_4	41.55	16.90	41.55	58.45	41.55
F_5	43.91	12.18	43.91	56.09	43.91
F_6	44.98	10.04	44.98	55.02	44.98
F_7	45.47	9.06	45.47	54.53	45.47
$F\infty$	45.87	8.26	45.87	54.13	45.87
y = 8 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	36.50	27.0	36.50	63.50	36.50
F_4	41.79	16.42	41.79	58.21	41.79
F_5	44.23	11.54	44.23	55.77	44.23
F_6	45.34	9.32	45.34	54.66	45.34
F_7	45.86	8.28	45.86	54.14	45.86
$F\infty$	46.30	7.40	46.30	53.70	46.30
y = 7 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	36.63	26.74	36.63	63.37	36.63
F_4	42.03	15.94	42.03	57.97	42.03
F_5	44.55	10.90	44.55	55.45	44.55
F_6	45.71	8.58	45.71	54.29	45.71
F_7	46.26	7.48	46.26	53.74	46.26
$F\infty$	46.73	6.54	46.73	53.27	46.73

	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 6 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	36.75	26.50	36.75	63.25	36.75
F_4	42.27	15.46	42.27	57.73	42.27
F_5	44.87	10.26	44.87	55.13	44.87
F_6	46.09	7.82	46.09	53.91	46.09
F_7	46.66	6.68	46.66	53.34	46.66
$F\infty$	47.17	5.66	47.17	52.83	47.17
y = 5 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	36.88	26.24	36.88	63.12	36.88
F_4	42.52	14.96	42.52	57.48	42.52
F_5	45.20	9.60	45.20	54.80	45.20
F_6	46.47	7.06	46.47	53.53	46.47
F_7	47.07	5.86	47.07	52.93	47.07
$F\infty$	47.62	4.76	47.62	52.38	47.62
y = 4 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	37.0	26.0	37.0	63.0	37.0
F_4	42.76	14.48	42.76	57.24	42.76
F_5	45.53	8.94	45.53	54.47	45.53
F_6	46.85	6.10	46.85	53.15	46.85
F_7	47.49	5.02	47.49	52.51	47.49
$F\infty$	48.07	3.86	48.07	51.93	48.07
y = 3 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	37.13	25.74	37.13	62.87	37.13
F_4	43.0	14.0	43.0	57.0	43.0
F_5	45.86	8.28	45.86	54.14	45.86
F_6	47.24	5.52	47.24	52.76	47.24
F_7	47.91	4.18	47.91	52.09	47.91
$F\infty$	48.53	2.74	48.53	51.47	48.53
y = 2 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	37.25	25.50	37.25	62.75	37.25
F_4	43.25	13.50	43.25	56.75	43.25
F_5	46.19	7.62	46.19	53.81	46.19
F_6	47.63	4.74	47.63	52.37	47.63
F_7	48.34	3.32	48.34	51.66	48.34
$F\infty$	49.01	1.98	49.01	50.99	49.01

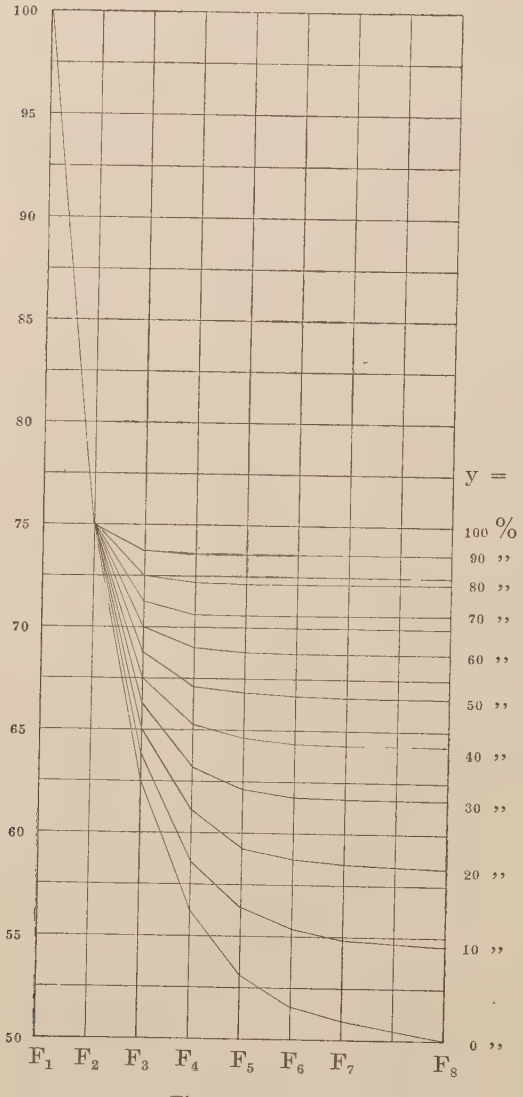
	AA	Aa	aa	A-Typus Dom.	a-Typus Rec.
y = 1 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	37.38	25.24	37.38	62.62	37.38
F_4	43.50	13.0	43.50	56.50	43.50
F_5	46.53	6.94	46.53	53.47	46.53
F_6	48.03	3.94	48.03	51.97	48.03
F_7	48.77	2.46	48.77	51.23	48.77
$F\infty$	49.50	1.00	49.50	50.50	49.50
y = 0 %					
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	37.50	25.0	37.50	62.50	37.50
F_4	43.75	12.5	43.75	56.25	43.75
F_5	46.90	6.2	46.90	53.10	46.90
F_6	48.45	3.1	48.45	51.55	48.45
F_7	49.20	1.6	49.20	50.80	49.20
$F\infty$	50.0	0.0	50.0	50.0	50.0

Figur 1 gibt diese Zahlen in graphischer Darstellung wieder.

Stellen wir nun daneben die Versuchsergebnisse, welche aus monohybriden Bastardierungen mit Erbsen, Bohnen, Ackerbohnen und Mays hervorgegangen sind.

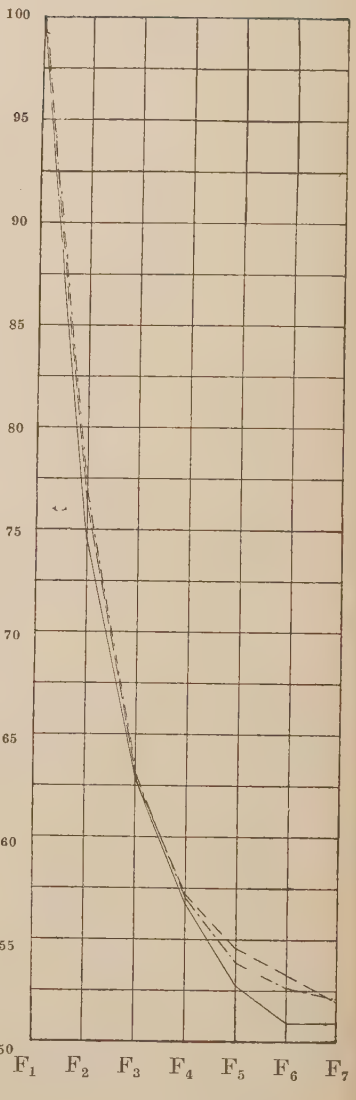
Erbsen. *Gelbe Kotyledonen × grüne. Ohne Selektion.*

Die Bastardierung wurde im Jahre 1914 angefertigt zwischen den Rassen „Stam Krombek" (gelbglatt) als Vaterpflanze und „Lentedopper" (grünglatt) als Mutter. In diesem Jahre wurden 24 Bastardsamen geerntet, welche also die F_1-Generation bildeten und die dominierende gelbe Kotyledonfarbe zeigten. Das nächste Jahr (1915) ergab als Ernte der 22 aufgezogenen F_1-Pflanzen im Ganzen 1091 Samen, von denen 818 gelb und 273 grün waren; aus diesen 1091 Samen wurden nach sorgfältiger Mischung 200 Samen gesät, davon 100 Pflanzen gezogen und aus der gut gemischten Ernte 3000 Samen entnommen und der Farbe nach gruppiert. Die Arbeitsweise im Jahre 1917 und folgenden Jahren war immer dieselbe: jedesmal wurde die ganze Ernte sorgfältig gemischt, 200 Samen wurden ausgelegt, 100 Pflanzen gezogen und von der Ernte 3000 Samen abgezählt und gruppiert. Sodann erhielt ich in den sieben gezogenen Generationen die nachfolgenden Zahlen:



Figur 1.

Kurven der theoretischen Prozentzahlen des dominanten A-Typus in den F_1-,F_2- und weiteren Generationen einer monohybriden Bastardierung bei y = 0 %, y = 10 % usw. Fremdbefruchtungen ohne Selektion.



Figur 2.

Kurven der experimentellen Verschiebung in monohybriden Erbsenkreuzungen ohne Selektion.

—— Ge.g. × Gr.g.
— — Ge.g. × Ge.r.
— . — Gr.g. × Gr.r.

TABELLE II.

	Gelb (A-Typus)	Grün (a)	% Gelb	% Grün	Mutmassliche Kreuzbefruchtung
F_1 (1914)	24	0	100.0	0.0	
F_2 (1915)	813	278	74.52	25.48	
F_3 (1916)	1883	1117	62.77	37.23	2—3 %
F_4 (1917)	1702	1298	56.73	43.27	1—2 %
F_5 (1918)	1581	1419	52.70	47.30	0 %
F_6 (1919)	1528	1472	50.93	49.07	0 %
F_7 (1920)	1529	1471	50.96	49.04	0—1 %

Eine Vergleichung der in dieser Weise erhaltenen Zahlen ergibt m.E. sofort eine genügende Bestätigung sowohl des mathematisch abgeleiteten Verlaufs der Population ohne Fremdbefruchtung, wie auch der in der Praxis allgemein angenommenen hochgradigen Selbstbefruchtung der Erbsen, obwohl das Vorkommen von Fremdbefruchtungen nicht völlig ausgeschlossen werden darf. Die aus diesen Zahlen hergeleitete Kurve (Fig. 2) ist dermassen der theoretischen y = 0 - Kurve ähnlich, dass jedenfalls etwaige Störungen durch Zertation, Substitution oder Elimination wohl nicht stattgefunden haben werden.

TABELLE III.

	I. Gelbglatt × gelbrunzelig.				
	Gl. A	R. a.	% A	% a	% Kr.
F_1 (1914)	29	0	100.0	0.0	
F_2 (1915)	1246	389	76.21	23.79	
F_3 (1916)	1887	1113	62.90	37.10	3—4
F_4 (1917)	1714	1286	57.13	42.87	3—4
F_5 (1918)	1638	1362	54.60	45.40	4—5
F_6 (1919)	1597	1403	53.23	46.77	4—5
F_7 (1920)	1559	1441	51.97	48.03	2—3

	II. Grünglatt × grünrunzelig.				
	Gl. A	R. a.	% A	% a	% Kr.
F_1 (1914)	21	0	100.0	0.0	
F_2 (1915)	757	231	76.82	23.18	
F_3 (1916)	1883	1117	62.77	37.23	2—3
F_4 (1917)	1711	1289	57.03	42.97	3—4
F_5 (1918)	1617	1383	53.90	46.10	2—3
F_6 (1919)	1579	1421	52.63	47.37	2—3
F_7 (1920)	1561	1439	52.03	47.97	2—3

Erbsen. *Glatte Samenform × runzelige. Ohne Selektion.* In ganz derselben Weise wie in der vorangehenden Untersuchung wurde gearbeitet mit einer Bastardierung einer gelbglatten (Stam Krombek) und einer gelbrunzeligen Rasse (Goldkönig[1]) und daneben mit derjenigen einer grünglatten (Lentedopper) und einer grünrunzeligen (Wonder van Amerika) Rasse. Die in Tabelle III zusammengetragenen Ergebnisse waren in der Hauptsache denjenigen der vorigen Kreuzung ähnlich, mit diesem wichtigen Unterschied aber, dass in beiden Reihen jetzt immer eine, es sei auch nicht grosse, Ueberzahl der dominanten, glattsamigen Individuen erhalten wurde. Diese Abweichung kann in zwei Ursachen ihren Grund finden: entweder die Selbstbefruchtung war in diesen Kulturen weniger stark, als in derjenigen der gelb × grün-Bastardierung, und würde hier also in einer zwischen 2 und 5 % wechselnden Frequenz stattgefunden haben, oder auch es gibt eine gewisse Konkurrenz zwischen den beiden Pollensorten: derjenigen mit der Anlage für glatte Samen und derjenigen mit dem rezessiven Faktor für runzelig, in dieser Weise, dass die „glatt"-Pollenkörner rascher keimen oder ihre Pollenschläuche schnelleres Wachstum zeigen als die „runzelig"-Pollenkörner. Die erstgenannte Erklärung erscheint mir mit Rücksicht auf die ganz gleichen Kulturumstände, welchen die Pflanzen sämtlicher Erbsenkreuzungen in demselben Jahre ausgesetzt waren, viel weniger wahrscheinlich, als die zweite; besonders wo Correns (1902. S. 162; 1917 S. 689) in seinen Mays-Bastardierungen ebenso fand, dass eine derartige Konkurrenz zwischen den beiden Pollentypen grosse Abweichungen der normalen monohybriden Mendelspaltung hervorrufen kann und dass auch hier der Unterschied zugunsten der „glatten" Pollenkörner liegt, obwohl er diesen Unterschied als viel beträchtlicher fand, als ich in meinen Bastardierungen. Ausserdem wird die letztere Annahme wahrscheinlicher durch die Tatsache, dass beide „glatt × runzelig" - Bastardierungen (I und II) F_2-Generationen ergaben, in welchen die glatten Samen in mehr als 75 % auftraten.

Bohnen. *Wagenaarrasse mit braunem Nabelring × Citroenrasse ohne oder mit blauem Nabelring. Ohne Selektion.* Die beiden Rassen von *Phaseolus vulgaris*: „Wagenaar" mit einem braunen Nabelring und „Citroen" ohne oder mit hell-

1) Ob hier wirklich die Rasse Goldkönig vorgelegen hat, ist nach den von White (1916) darüber veröffentlichten Versuchen fraglich.

blauem Nabelring ergeben nach ihrer Bastardierung eine monohybride Spaltung, wobei die braune Farbe der Wagenaar-Rasse sich als dominierend zeigt. Dieser monohybride Bastard wurde in 1914 als ein F_1-Individuum, in 1916 noch einmal als ein F_1-Individuum gezogen. Die Nachkommenschaft der ersten Kreuzung erreichte also im Jahre 1920 ihre siebente Generation, diejenige des zweiten Bastards in 1922. Mit Rücksicht auf Einflüsse des Wetters, welche für die Frequenz der Kreuzbefruchtung verschiedene Bedeutung haben konnten, sind beide Kulturen stets getrennt gehalten. Die erste Bastardierung ergab 41 Individuën als F_2-Generation, die zweite 34 Pflanzen. Die Samen dieser F_2-Pflanzen wurden sorgfältig gemischt, womöglich 600 davon ausgelegt und 500 Pflanzen geerntet. Die Trennung dieser Pflanzen, je nachdem die Nabelfarbe ihrer Samenschale braun oder weiss (bläulich) war, ergab nun die nachfolgenden Zahlenverhältnisse, welche in der unterstehenden Tabelle zusammengestellt worden sind (vgl. auch die Kurve in Fig. 3).

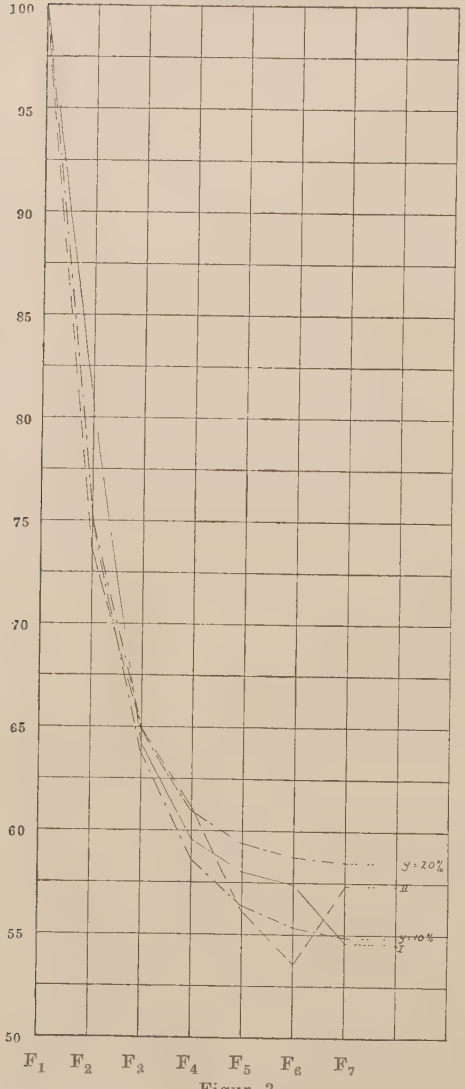
TABELLE IV. BOHNEN WAGENAAR × CITROEN. OHNE SELEKTION.

I	Wag. A	Citr. a.	% A	% a	% Kr.
F_1 (1914)	1	0	100.0	0.0	
F_2 (1915)	33	8	80.49	19.51	
F_3 (1916)	321	179	64.20	35.80	14
F_4 (1917)	298	202	59.60	40.40	13
F_5 (1918)	290	210	58.00	42.00	16
F_6 (1919)	287	213	57.40	42.60	16
F_7 (1920)	273	227	54.60	45.40	9

II	Wag. A	Citr. a	% A	% a	% Kr.
F_1 (1916)	1	0	100.0	0.0	
F_2 (1917)	25	9	73.53	26.47	
F_3 (1918)	324	176	64.80	35.20	16
F_4 (1919)	306	196	61.20	38.80	21
F_5 (1920)	281	219	56.20	43.80	13
F_6 (1921)	268	232	53.60	46.40	6
F_7 (1922)	287	213	57.40	42.60	19

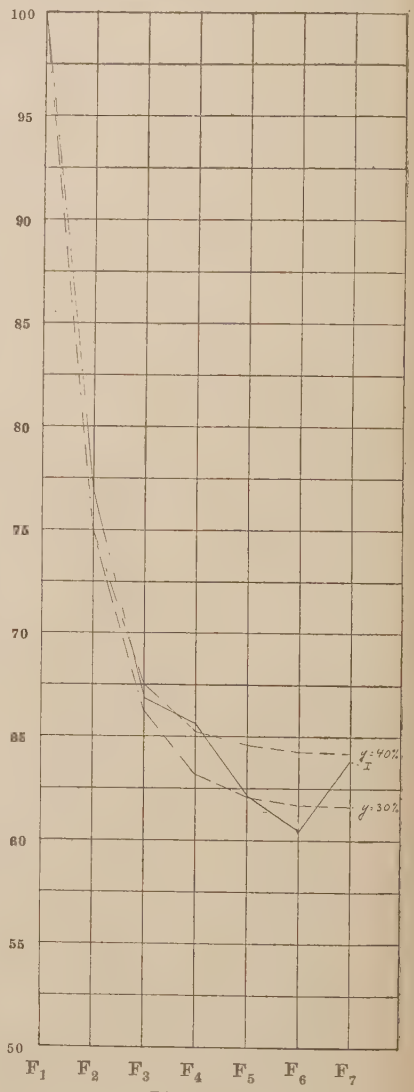
Obschon diese Zahlen, der Natur des Materials gemäss, kleiner sind als diejenigen, welche in den vorangehenden Erbsen-Bastardierungen erhalten wurden, und also den Prozentzahlen in ihren zweiten Dezimalziffern genaue Zuverlässigkeit fehlt, glaube ich dennoch zur Schlussfolgerung berechtigt zu sein, dass die Kreuzbefruchtung bei *Phaseolus vulgaris* in unserer

Gegend meistens zwischen 10 und 20 Prozent schwankt. Diese Zahlen sind zwar höher als diejenigen, welche in der betreffenden Litteratur angegeben worden sind (Emerson 1904, 1916, Mayer Gmelin 1916, Schiemann 1921, Lenz 1921 und Kristofersson 1921), wo man vielfach Zahlen



Figur 3.

Kurven der experimentellen Verschiebung in monohybriden Bohnenkreuzungen ohne Selektion mit den theoretischen Kurven für y = 10% und y = 20%.



Figur 4.

Kurven der experimentellen Verschiebung in einer monohybriden Ackerbohnenkreuzung ohne Selektion mit den theoretischen Kurven für y = 30% und y = 40%.

um 4 Prozent Fremdbefruchtungen findet, aber dennoch glaube ich die meinigen als mehr der Wirklichkeit annähernd, als die übrigen. Denn die von diesen Autoren angegebenen Frequenzen wurden hergeleitet aus Prozentzahlen der bemerklichen Bastardpflanzen, welche aus nebeneinander gezogenen Bohnenkulturen herstammten. Aber in dieser Weise werden nicht nur die in dominanten Rassen auftretenden Bastardpflanzen, welchen eine rezessive Rasse als Vater gedient hatte (z.B. Wagenaar ♀ × Citroen ♂) vielfach vernachlässigt, sondern auch wurden die verschiedenen Rassen zwar nebeneinander, aber nicht untereinander gezogen; d.h. die erhaltenen spontanen Bastardierungen kamen nur her von zwei in einer gewissen Distanz stehenden Pflanzen, während die Bastardierungen zweier nebeneinanderstehenden, zur selben Rasse gehörigen Pflanzen, selbstverständlich nicht beobachtet werden konnten. Darum ist m. E. die von mir jetzt benutzte Methode zur Bestimmung der Fremdbefruchtungsfrequenz die bessere.

Ackerbohnen. *Schwarze Nabelfarbe × weisse. Ohne Selektion.* In ganz derselben Weise wie die Versuche mit Bohnen angeordnet waren, ist auch eine Bastardierung mit Ackerbohnen

TABELLE V. ACKERBOHNEN, SCHWARZNABEL × WEISSNABEL. ONHE SELEKTION.

	Schw. A	W. a.	% A	% a	% Mutmassliche Kreuzbefruchtung.
F_1 (1916)	12	0	100.0	0.0	
F_2 (1917)	76	23	76.76	23.24	
F_3 (1918)	334	166	66.80	33.20	34
F_4 (1919)	328	162	65.60	34.40	41
F_5 (1920)	311	189	62.20	37.80	31
F_6 (1921)	302	198	60.40	39.60	25
F_7 (1922)	319	181	63.80	36.20	38

(*Vicia Faba*) vorgenommen worden, welche auf die Farbe des Nabels Beziehung hatte. Unter Bohnen der Rasse Mazagan, eine ziemlich niedrige, reichblühende Rasse, finden sich vielfach Samen, deren Nabelfarbe nicht schwarz, wie das Rassenmerkmal sein soll, sondern weiss ist. Dieser Unterschied beruht auf einem einzigen Faktor; die Bastardierung der zwei Typen folgt also dem monohybriden Spaltungsschema. Zwölf F_1-Pflanzen in 1916 gezogen, zeigten die Dominanz der schwarzen Nabelfarbe; in F_2 trat Spaltung in 76 schwarznabelige und 23

weissnabelige Pflanzen ein und aus ihrer Ernte wurden wieder 600 Samen entnommen, davon 500 Pflanzen gezogen u.s.w. In Tabelle V finden sich die in den hintereinander folgenden Generationen erhaltenen Zahlen zusammen.

Aus diesen Zahlen kann man also mit einiger Bestimmtheit herleiten, dass die Fremdbefruchtung der Ackerbohnen um vieles stärker ist als diejenige der Fisolen und zwar dass sie in meinen Kulturen zwischen 25 und 40 Prozent schwankte. Die in Figur 4 gegebene graphische Darstellung, in welcher auch die theoretischen Linien für $y = 30\ \%$ und $y = 40\ \%$ noch einmal wiedergegeben sind, zeigt auch dieses sehr deutlich.

Mays. *Blaue Endospermfarbe × weisse Farbe. Ohne Selektion.*

Als vierte Reihe von Kulturen wurden zwei, schon von vorher als monohybride Spaltungen bekannte Faktoren der Maispflanze gewählt; der eine war der Faktor für blaues Endosperm gegenüber demjenigen des weissen; der zweite war der Faktor für glatte Samenform, dem der Faktor für runzelige rezessive Samenform gegenüber stand.

Eine in 1918 ausgeführte Bastardierung zwischen einem Blauglatten und einem Weissglatten Mays ergab in diesem Jahre 37 Bastardsamen, welche selbstverständlich die blaue Farbe hatten. Ihre Keimung lieferte 36 gut-ausgebildete Pflanzen, deren Kolben zusammen mehr als 10.000 Samen trugen. Davon wurden nach genauer Mischung 10.000 abgezählt und gruppiert; dieser Menge ohne jede Auswahl 200 Samen entnommen und zur Keimung gebracht, 100 Pflanzen gezogen und von ihrer Ernte wieder 10.000 Samen abgezählt u.s.w. Die Zahlenverhältnisse waren wie aus der folgenden Tabelle ersichtlich (vgl. Fig. 5):

TABELLE VI. MAYS, BLAUES ENDOSPERM × WEISSES. OHNE SELEKTION.

	Bl. A	W. a.	% A	% a	Mutmassliche Kreuzbefruchtung
F_1 (1918)	37	0	100.0	0.0	
F_2 (1919)	7521	2479	75.21	24.79	
F_3 (1920)	7463	2537	74.63	25.37	96
F_4 (1921)	7513	2487	75.13	24.87	>100
F_5 (1922)	7389	2611	73.89	26.11	92

Aus diesen Zahlen kann also auf eine sehr starke Frembe-

fruchtung der Mayspflanze geschlossen werden [1]), welche jedenfalls zwischen 90 und 100 % schwankt; eine Schlussfolgerung, welche im Voraus erwartet werden konnte. Und dennoch hat auch diese Untersuchung ihre Bedeutung, weil sie doch auch eine glatte Bestätigung gibt der auf mathematischem Wege für Fremdbefruchtung festgestellten Populationsverschiebung. Und noch in einer anderen Hinsicht ist diese Kulturreihe von Wert, falls sie verglichen wird mit den Ergebnissen, zu welchen die andere Mays-Bastardierung geführt hat.

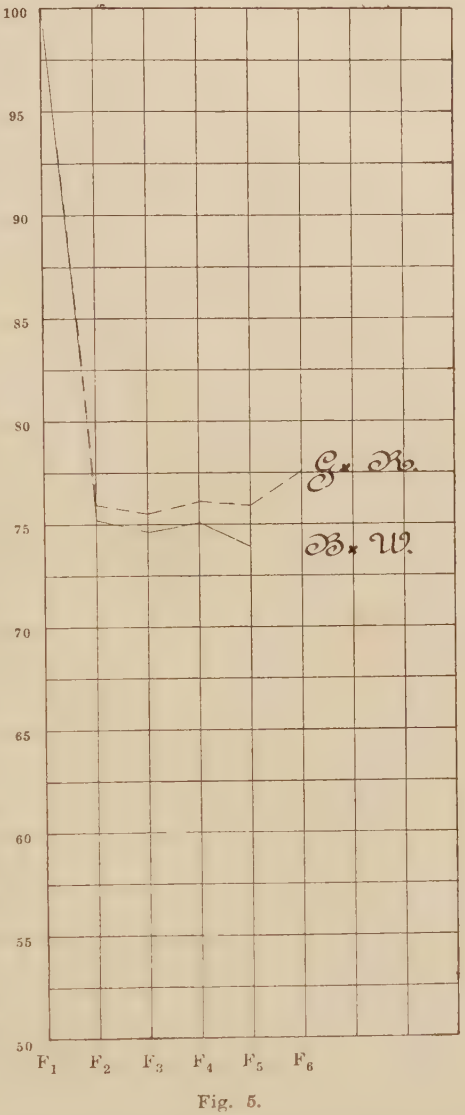


Fig. 5.

Kurven der experimentellen Verschiebung nach monohybriden Mays-Bastardierungen (G × R = Glatt × runzelig, B × W = Blau × weiss) Ohne Selektion.

Mays. *Glatte Samenform × runzelige. Ohne Selektion.* Die andere Bastardierung mit Mays wurde zwischen einer blauglatten und einer blaurunzeligen Rasse dargestellt; während die F_1-Generation jezt 26 Pflanzen umfasste, zählte die F_2 im Ganzen 8365 Körner, wovon 6356 glatt und 2009 runzlig waren. Die Arbeitsweise war im Wesentlichen dieselbe als in der vorigen Mays-Bastardierung. Die Tabelle VII gibt die Zahlen der nachfolgenden Generationen (vgl. Fig. 5):

In allen diesen Generationen würde man sogar

1) Für die von Jones (1920) erwähnte Bevorzugung des eigenen Pollens in der gemischten Bestäubung, haben meine Zahlen jedenfalls keine Andeutung gegeben.

TABELLE VII. MAYS. GLATTE SAMENFORM × RUNZELIGE. OHNE SELEKTION.

	Gl. A	R. a	% A	% a	Mutmassliche Kreuzbefruchtung
F_1 (1917)	26	0	100.0	0.0	
F_2 (1918)	6356	2009	75.98	24.02	
F_3 (1919)	7551	2449	75.51	24.49	>100
F_4 (1920)	7618	2382	76.18	23.82	>100
F_5 (1921)	7594	2406	75.94	24.06	>100
F_6 (1922)	7763	2237	77.63	22.37	>100

auf eine Fremdbefruchtung von mehr als 100 % schliessen wollen! Die Ursache dieser hohen Prozenten der glatten Samen liegt hier aller Wahrscheinlichkeit nach, in der obengenannten Zertation oder Konkurrenz, welche den Pollenschläuchen mit dem „Glatt"-Faktor den Vorzug gibt und sie in Mehrheit die Embryosäcke erreichen lässt, während die langsameren „Runzelig" Pollenschläuche etwas später ankommen. Darin kann die grosse Zahl der glatten Samen, eine gute Erklärung finden, besonders wenn man diese neben die Correns'schen Ergebnisse, sowie neben die obengenannten Erbsenbastardierungen stellt.

* * *

b. Monohybride Bastardierung und ihre Nachkommenschaft unter fortwährender Selektion des dominanten A-Typus und Vernichtung der ausmendelnden rezessiven a-Individuen.

Für die mathematische Grundlage der Zusammensetzung einer nach monohybrider Bastardierung entstandenen Population in welcher die rezessive Form fortwährend ausgemerzt wird und welche sich völlig panmiktisch, also mit y = 100 % Kreuzbefruchtungen vermehrt, liegt die von Wentworth und Remick (1916 p. 615) ausgearbeitete allgemeine Formel:

$$[2r + (n\text{-}1)\,s]^2\,AA + 2s\,[2r + (n\text{-}1)\,s]\,Aa + s^2\,aa,$$

worin r und s die numerischen Verhältnisse der in der Anfangspopulation schon vorhandenen AA-, bzw. Aa - Gruppen darstellen, während n die Nummer der Generation angibt (wobei F_2 wieder als erste Generation G_1 benannt ist). Für die

in unserem Fall selbstverständlich gültigen Werte r = 1 und s = 2 wird diese Formel:

$$(Gn)\ n^2\ AA + 2n\ Aa + aa,$$

oder mit Transponierung der mendelistischen n-Wert, jetzt:

$$(n\text{-}1)^2\ AA + 2\ (n\text{-}1)\ Aa + aa.$$

Der Verlauf einer solchen panmiktischen Population, welche also einer monofaktoriellen Bastardierung und nachheriger andauernder Selektion der dominanten Typen nebst Ausmerzung der Rezessiven ihre Entstehung verdankt, ist aus nachstehender Tabelle sofort ersichtlich:

TABELLE VIII.

	% A A	% Aa	% aa	% Dom. A	% Rec. a
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	44.44	44.44	11.11	88.89	11.11
F_4	56.25	37.50	6.25	93.75	6.25
F_5	64.00	32.00	4.00	96.00	4.00
F_6	69.46	27.77	2.77	97.23	2.77
F_7	73.47	24.49	2.04	97.96	2.04
F_8	76.57	21.87	1.56	98.44	1.56
F_9	79.01	19.76	1.23	98.77	1.23
F_{10}	81.0	18.0	1.0	99.0	1.0
F_{11}	82.64	16.54	0.82	99.18	0.82
F_{12}	84.03	15.28	0.69	99.31	0.69
F_{13}	85.21	14.20	0.59	99.41	0.59
F_∞	100.0	0.0	0.0	100.0	0.0

Für das andere Extrem, den Verlauf einer monohybriden Population mit völliger Selbstbefruchtung und Ausmerzung der Rezessiven, ist m.W. noch keine allgemein-gültige mathematische Formel veröffentlicht worden. Diese kann aber sehr leicht abgeleitet werden, wenn man nur ein jedes Individuum 4 Nachkommen hervorbringen lässt; jedes AA-Individuum gibt dann 4 AA-Nachkommen, jede Heterozygote Aa wird 1 AA : 2 Aa : 1 aa ergeben. Sind in der Ausgangspopulation G_1, die drei Typen wieder als r : s : t vorhanden, so wird die Zusammensetzung der nachher folgenden Generationen:

	AA	Aa	aa
G_1	r	s	t
G_2	4r + s	2s	s
G_3	4(4r + s) + 2s	4s	2s oder
	8r + 3s	2s	s
G_4	4(8r + 3s) + 2s	4s	2s oder
	16r + 7s	2s	s
G_5	32r + 15s	2s	s
G_6	64r + 31s	2s	s
G_n	$2^n r + (2^{n-1}-1)s$	2s	s

Nach Transponierung der n als n-1, lautet diese Formel also für die

$$F_n = [2^{n-1} r + (2^{n-2}-1)s]\ AA + 2\ s\ Aa + s\ aa.$$

Tauscht man jetzt r und s gegen die in F_2 vorhandenen Werte $r = 1$ und $s = 2$ um, so ergibt sich für diesen Spezialfall

$$F_n = [2^{n-1} + 2\ (2^{n-2}-1)]\ AA + 4\ Aa + 2\ aa \text{ oder:}$$

$$F_n = (2^{n-1}-1)\ AA + 2\ Aa + aa$$

In nachstehender Tabelle sind diese Zahlen wieder für eine Reihe nacheinanderfolgender Generationen berechnet worden:

TABELLE IX.

	% AA	% Aa	% aa	% Dom. A	% Rez. a.
F_1	0.0	100.0	0.0	100.0	0.0
F_2	25.0	50.0	25.0	75.0	25.0
F_3	50.0	33.34	16.66	83.34	16.66
F_4	70.0	20.0	10.0	90.0	10.0
F_5	83.33	11.11	5.55	94.45	5.55
F_6	91.18	5.88	2.94	97.06	2.94
F_7	95.46	3.03	1.51	98.49	1.51
F_8	97.69	1.54	0.77	99.23	0.77
F_9	98.83	0.78	0.39	99.61	0.39
F_{10}	99.41	0.46	0.23	99.77	0.23
F_{11}	99.70	0.20	0.10	99.90	0.10
F_{12}	99.92	0.05	0.03	99.97	0.03
F_{13}	99.96	0.03	0.01	99.99	0.01
F_∞	100.0	0.00	0.00	100.0	0.00

Vergleichung der panmiktischen (y = 100 %) mit der autogamen (y = 0 %) Population, welche beide in Figur 6 in graphischer Darstellung wiedergegeben sind, ergibt sofort, dass die Zahl der dominanten Typen in der panmiktischen Popu-

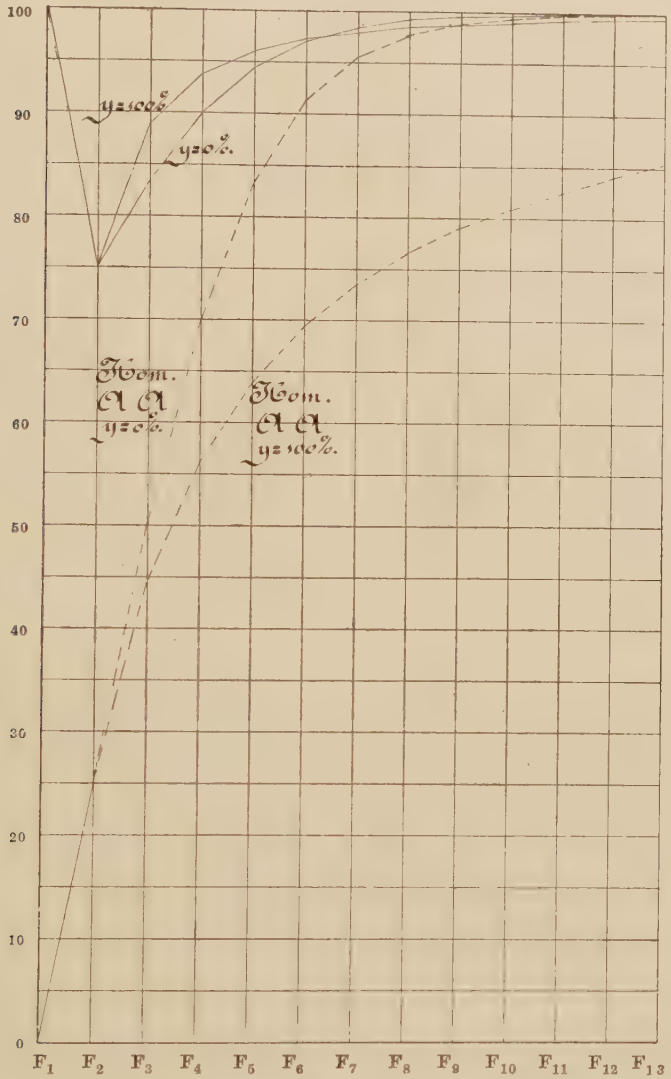


Fig. 6.

Kurven der theoretischen Verschiebung des dominanten A-Typus einer monohybriden Bastardierung mit y = 0 % und y = 100 % Fremdbestäubungen, sowie der Homozygoten (AA)-Zahlen bei y = 0 % und y = 100 % unter fortwährender Selektion des dominanten A-Typus.

lation zwar im Anfang schneller ansteigt, als in der autogamen, später aber, zwischen F_6 und F_7 von der autogamen eingeholt wird, sodass diese in der F_8 die 99% schon übersteigt, jene erst in der F_{10}. Die autogame Population erreicht also ihre praktische Homogenität früher als die panmiktische.

Die Kurven der Homozygotenzahl zeigten einen grösseren Unterschied: jene der panmiktischen Population erreicht in der F_{13} noch gar nicht die Zahl 90 %, welche von der autogamen Population in der F_6 schon überschritten wird.

Die geringe Distanz zwischen den beiden Kurven des dominanten A-Typus hat zur Folge, dass es sehr wenig lohnend sein würde, auch die Frequenzzahlen unter wechselnder Kreuzbefruchtung ($y = 10$ % u.s.w. bis $y = 90$ %) zu berechnen und ihre Kurve darzustellen; dieses habe ich deswegen unterlassen.

Auf eine derartige Verschiebung der Zahlenverhältnisse bezieht sich die Arbeit Heribert Nilssons (1921), der aus seiner Roggenbastardierung: gereifter Roggen (dominant) × wachsfreier (rezessiv) eine glatte Bestätigung des Verlaufs einer panmiktischen Population herleiten konnte.

Meine eigenen diesbezüglichen Versuche sind mit den obengenannten Arten ausgeführt worden: Erbsen, Bohnen, Ackerbohnen und Mays. Die Arbeitsweise war dieselbe als diejenige in der vorigen Versuchsreihe, selbtsverständlich mit Ausnahme der jetzt immer vorgenommenen Selektion dominanter Individuen.

Die Ergebnisse können in nachfolgender Weise tabellarisch zusammengefasst werden. Zur Vergleichung sind jedesmal die theoretischen Zahlen der panmiktischen und der autogamen Population dazugefügt.

TABELLE X. ERBSEN. GELB × GRÜN MIT SELEKTION DER DOMINANTEN.

	Gelb A	Grün a	% A	% a	% A Panm.	% A Autog.
F_1 (1914)	21	0	100.0	0.0	100.0	100.0
F_2 (1915)	689	227	75.22	24.78	75.0	75.0
F_3 (1916)	2509	481	83.63	16.37	88.89	83.34
F_4 (1917)	2713	287	90.43	9.57	93.75	90.0
F_5 (1918)	2830	170	94.33	5.67	96.0	94.45
F_6 (1919)	2913	87	97.10	2.90	97.23	97.06
F_7 (1920)	2957	43	98.57	1.43	97.96	98.49

TABELLE XI. BOHNEN, WAGENAAR × CITROEN MIT SELEKTION DER DOMINANTEN.

	Wag. A	Citr. a	% A	% a	% A Panm.	% A Autog.
F_1 (1916)	3	0	100.0	0.0	100.0	100.0
F_2 (1917)	46	12	79.31	20.69	75.0	75.0
F_3 (1918)	429	71	85.80	14.20	88.89	83.34
F_4 (1919)	458	42	91.60	8.40	93.75	90.0
F_5 (1920)	471	29	94.20	5.80	96.0	94.45
F_6 (1921)	479	21	95.80	4.20	97.23	97.06
F_7 (1922)	494	6	98.80	1.20	97.96	98.49

TABELLE XII. ACKERBOHNEN. SCHWARZNABEL × WEISSNABEL MIT SELEKTION DER DOMINANTEN.

	Schw. A	W. a	% A	% a	% A Panm.	% A Autog.
F_1 (1916)	6	0	100.0	0.0	100.0	100.0
F_2 (1917)	92	34	73.01	26.99	75.0	75.0
F_3 (1918)	437	63	87.20	12.80	88.89	83.34
F_4 (1919)	464	36	92.80	7.20	93.75	90.0
F_5 (1920)	477	23	95.40	4.60	96.0	94.45
F_6 (1921)	487	13	97.40	2.60	97.23	97.06
F_7 (1922)	492	8	98.40	1.60	97.96	98.49

TABELLE XIII. MAYS. BLAU × WEISS, MIT SELEKTION DER DOMINANTEN.

	Bl. A	W. a	% A	% a	% A Panm.	% A Autog.
F_1 (1918)	41	0	100.0	0.0	100.0	0.0
F_2 (1919)	7486	2514	74.86	25.14	75.0	75.0
F_3 (1920)	8879	1121	88.79	11.21	88.89	83.34
F_4 (1921)	9373	627	93.73	6.27	93.75	90.0
F_5 (1922)	9604	396	96.04	3.96	96.0	94.45

Aus diesen Zahlen folgt sofort, dass der Versuch mit Erbsen ein Resultat ergeben hat, welches mit der Erwartung für eine autogame Population eine befriedigende Uebereinstimmung zeigt; die meisten Zahlen sind zwar etwas zu hoch, aber doch sehr wenig; die Kurve (Fig. 7) deckt sich fast völlig mit derjenigen der Autogamie.

Die Mays-Zahlen bringen eine Bestätigung der panmiktischen Populationsänderung; die Uebereinstimmung der Kurven ist hier ja noch besser als bei den Erbsen. Dagegen halten die Versuche mit Bohnen und mit Ackerbohnen die Mitte zwischen

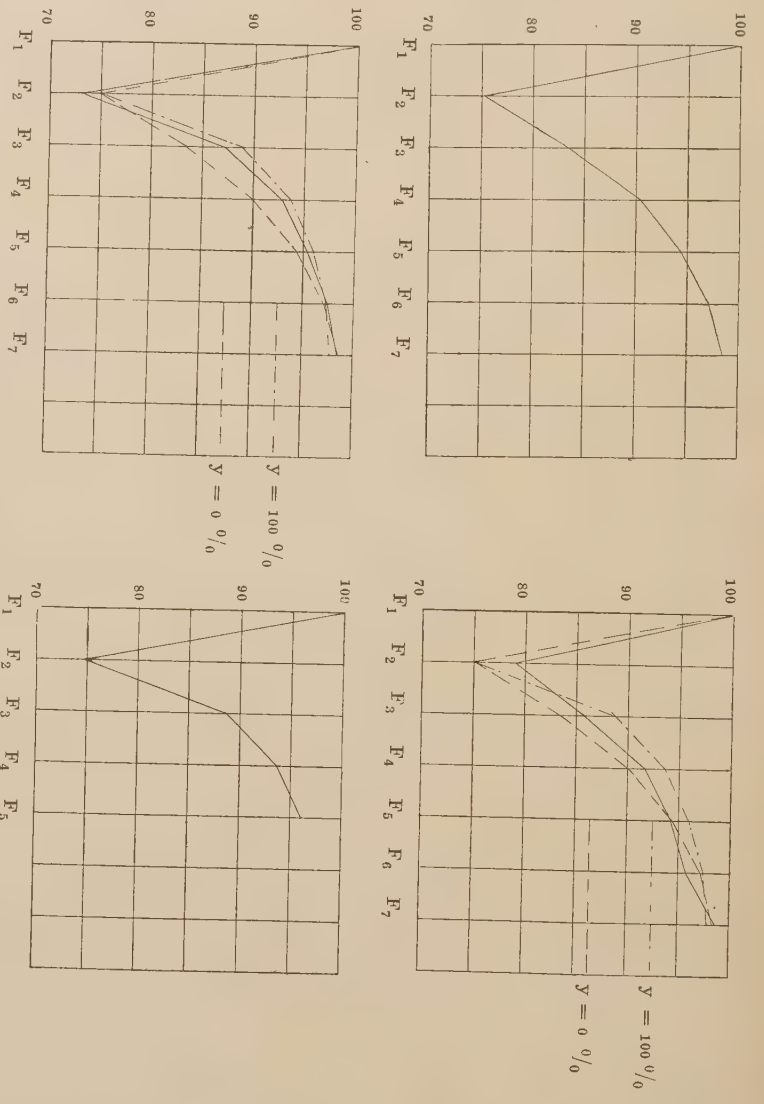


Fig. 7. 1—4.
Vier Kurven der experimentellen Verschiebung des dominanten A-Typus nach monohybrider Bastardierung (Erbsen, Bohnen, Ackerbohnen und Mays) unter fortwährender Selektion der Dominanten.

dem Fall der Autogamie und dem der Panmixie; wie die graphischen Darstellungen in Fig. 7 zeigen, hat sich die Kurve der Bohnen etwas mehr der der Autogamie genähert als diejenige

der Ackerbohnen, welche dichter neben der Panmixie-Kurve geht. Dieses ist in voller Uebereinstimmung mit dem oben gefundenen höheren Prozentsatz der Fremdbefruchtung bei Ackerbohnen.

* * *

c. Dihybride Bastardierung und die Nachkommenschaft ohne Selektion.

Die mathematische Bearbeitung der Verschiebung, welche in einer aus bifaktorieller Bastardierung hervorgegangenen Population unter verschiedenen Fremdbefruchtungsfrequenzen stattfindet, verdanken wir wieder Heukels (1915 S. 309 ff). In einer solchen Population sind selbstverständlich 4 homozygote Typen (AABB, AAbb, aaBB, und aabb) vorhanden, sowie auch 4 monoheterozygote Typen (AaBB, Aabb, AABb und aaBb), während nur ein diheterozygoter Typus darin anwesend sein kann (AaBb). Die 4 erstgenannten Typen sind in gleicher, von Heukels p genannten Zahl, die 4 Monoheterozygoten auch in gleicher Zahl u.zw. je q und der diheterozygote Typus in r Individuen anwesend. Deshalb soll 4 p + 4 q + r = 1 sein und ist der Phaenotypus mit beiden dominanten Faktoren = p + 2 q + r, jeder der A - oder B-Typen als p + q und die doppeltrezessive Form = p.

Durch genaue Berechnungen hat Heukels für die Werte p, q und r Formeln aufdecken können, welche hier wieder mit Transponierung der n-Bezeichnung wiedergegeben sind.

In der F_n-Generation ist

$$4p_n = \frac{(3x+2y)\ (x+y)}{(x+2y)(3x+4y)} - \left\{\frac{x}{2(x+y)}\right\}^{n-2} \times \frac{x}{x+2y} + \left\{\frac{x}{4(x+y)}\right\}^{n-2} \times \frac{3x}{4(3x+4y)}$$

$$4q_n = \frac{4y\ (x+y)}{(x+2y)(3x+4y)} + \left\{\frac{x}{2(x+y)}\right\}^{n-2} \times \frac{x}{x+2y} - \left\{\frac{x}{4(x+y)}\right\}^{n-2} \times \frac{3x}{2\,(3x+4y)}$$

$$r_n = \frac{y}{3x+4y} + \left\{\frac{x}{4(x+y)}\right\}^{n-2} \times \frac{3x}{4(3x+4y)}$$

Für den uns hier interessierenden Spezialfall der Diheterozygote mit völlig unabhängiger Spaltung der beiden Faktorenpaaren und absoluter Selbstbefruchtung, bzw. absoluter Panmixie, sind selbstverständlich wohl einfachere Formeln anwendbar, deren mathematische Ableitung viel leichter ist. Als solche dürfen gelten:

Für absolute Selbstbefruchtung auf einem Total von 2^{2n} Individuen wird $p_n = (2^{n-1}-1)^2$, $q_n = 2^n-2$ und $r_n = 2^2$.

Für absolute Panmixie bleibt die Population fortwährend dieselbe (wie dies auch für die Monoheterozygoten galt) u.zw. bleiben immer:

p = 1, q = 2 und r = 4 auf einem Total von 16 Individuen.

Mit Hilfe der von Heukels berechneten Formeln kann man auch hier also eine Tabelle zusammenstellen, worin für jeden Wert der Fremdbefruchtungsfrequenz (y = 0, y = 10, y = 20 usw.) die dazugehörigen Werte der p, q und r, sowie die prozentischen Frequenzen der Doppeldominanten, also des AB-Typus, der Einfachdominanten (Ab-oder aB-Typus) und der Rezessiven vom ab-Typus, angegeben sind:

TABELLE XIV.

	p	q	r	AB-Typus	Ab-oder aB-Typus	ab-Typus
y=100%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	6.25	12.50	25.0	56.25	18.75	6.25
F_4	6.25	12.50	25.0	56.25	18.75	6.25
F_5	6.25	12.50	25.0	56.25	18.75	6.25
F_6	6.25	12.50	25.0	56.25	18.75	6.25
F_7	6.25	12.50	25.0	56.25	18.75	6.25
$F\infty$	6.25	12.50	25.0	56.25	18.75	6.25
y=90%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	7.05	12.17	23.13	54.52	19.22	7.05
F_4	7.08	12.16	23.08	54.44	19.24	7.08
F_5	7.08	12.16	23.08	54.44	19.24	7.08
F_6	7.08	12.16	23.08	54.44	19.24	7.08
F_7	7.08	12.16	23.08	54.44	19.24	7.08
$F\infty$	7.08	12.16	23.08	54.44	19.24	7.08
y=80%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F	6.25	12.50	25.0	56.25	18.75	6.25
F_3	7.82	11.88	21.22	52.80	19.69	7.82
F_4	8.02	11.72	21.03	52.50	19.74	8.02
F_5	8.03	11.70	21.02	52.49	19.74	8.03
F_6	8.03	11.70	21.02	52.49	19.74	8.03
F_7	8.03	11.70	21.02	52.49	19.74	8.03
$F\infty$	8.03	11.70	21.02	52.49	19.74	8.03

	p	q	r	AB-Typus	Ab-oder aB-Typus	ab-Typus
y = 70%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	8.57	11.58	19.38	51.13	20.15	8.57
F_4	9.03	11.24	18.96	50.43	20.27	9.03
F_5	9.12	11.16	18.93	50.32	20.28	9.12
F_6	9.15	11.15	18.93	50.29	20.28	9.15
F_7	9.15	11.15	18.93	50.29	20.28	9.15
$F\infty$	9.15	11.15	18.93	50.29	20.28	9.15
y = 60%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	9.38	11.25	17.50	49.38	20.62	9.38
F_4	10.19	10.63	16.75	48.19	20.81	10.19
F_5	10.38	10.45	16.68	47.96	20.83	10.38
F_6	10.42	10.42	16.66	47.92	20.83	10.42
F_7	10.42	10.42	16.66	47.92	20.83	10.42
$F\infty$	10.42	10.42	16.66	47.92	20.83	10.42
y = 50%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	10.15	10.94	15.63	47.67	21.09	10.15
F_4	11.43	9.95	14.46	45.79	21.39	11.43
F_5	11.78	9.64	14.31	45.36	21.43	11.78
F_6	11.88	9.55	14.29	45.26	21.43	11.88
F_7	11.89	9.53	14.29	45.25	21.43	11.89
$F\infty$	11.90	9.52	14.29	45.24	21.43	11.90
y = 40%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	10.95	10.62	13.74	45.93	21.56	10.95
F_4	12.76	9.23	12.05	43.26	21.99	12.76
F_5	13.39	8.66	11.80	42.51	22.05	13.39
F_6	13.58	8.48	11.77	42.30	22.06	13.58
F_7	13.64	8.42	11.76	42.24	22.06	13.64
$F\infty$	13.65	8.40	11.76	42.33	22.06	13.65

	p	q	r	AB-Typus	Ab-oder aB-Typus	ab-Typus
y = 30%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	11.71	10.32	11.87	44.23	22.03	11.71
F_4	14.20	8.41	9.57	40.58	22.61	14.20
F_5	15.16	7.54	9.18	39.44	22.70	15.16
F_6	15.52	7.20	9.11	39.04	22.72	15.52
F_7	15.65	7.07	9.09	38.91	22.72	15.65
$F\infty$	15.72	7.01	9.09	38.84	22.72	15.72
y = 20%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	12.56	9.94	10.0	42.44	22.50	12.56
F_4	15.76	7.49	7.0	37.74	23.25	15.76
F_5	17.21	6.19	6.40	35.99	23.40	17.21
F_6	17.82	5.61	6.28	35.32	23.43	17.82
F_7	18.07	5.37	6.26	35.05	23.44	18.07
$F\infty$	18.23	5.21	6.25	34.89	23.44	18.23
y = 10%						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	13.31	9.62	8.24	40.81	22.94	13.31
F_4	17.41	6.51	4.36	34.77	23.91	17.41
F_5	19.46	4.67	3.48	32.28	24.13	19.46
F_6	20.44	3.74	3.29	31.20	24.18	20.44
F_7	20.89	3.30	3.24	30.73	24.19	20.89
$F\infty$	21.25	2.94	3.22	30.35	24.19	21.25
y = 0 %						
F_1	0.0	0.0	100.0	100.0	0.0	0.0
F_2	6.25	12.50	25.0	56.25	18.75	6.25
F_3	14.06	9.38	6.25	39.06	23.44	14.06
F_4	19.14	5.47	1.56	31.64	24.61	19.14
F_5	21.98	2.92	0.39	28.22	24.90	21.98
F_6	23.46	1.52	0.10	26.58	24.98	23.46
F_7	24.23	0.76	0.02	25.79	24.99	24.23
$F\infty$	25.0	0.	0.	25.0	25.0	25.0

Der Verlauf des AB-Typus unter verschiedenen y-Werten ist in Figur 8, derjenige des Ab-oder des aB-Typus in Figur 9 wiedergegeben.

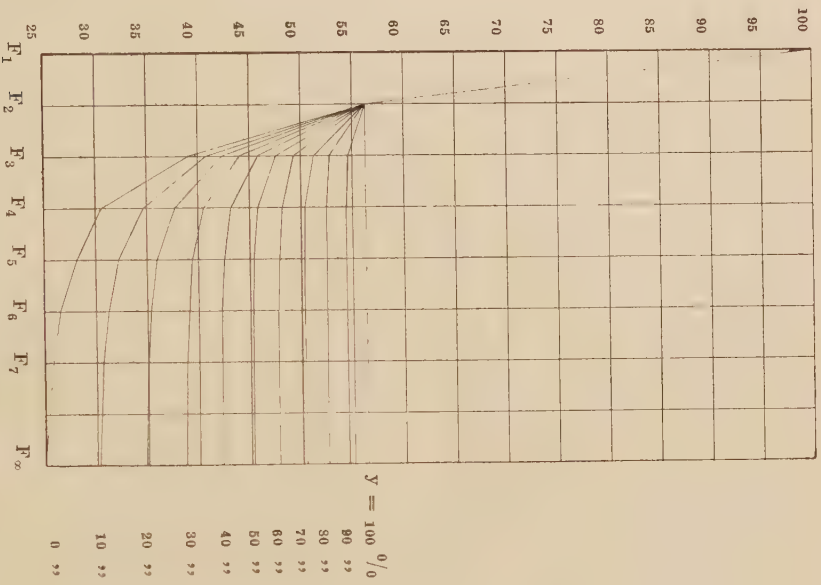


Fig. 8.

Kurven der theoretischen Verschiebung des doppeldominanten AB-Typus nach dihybrider Bastardierung mit y = 0 % usw.

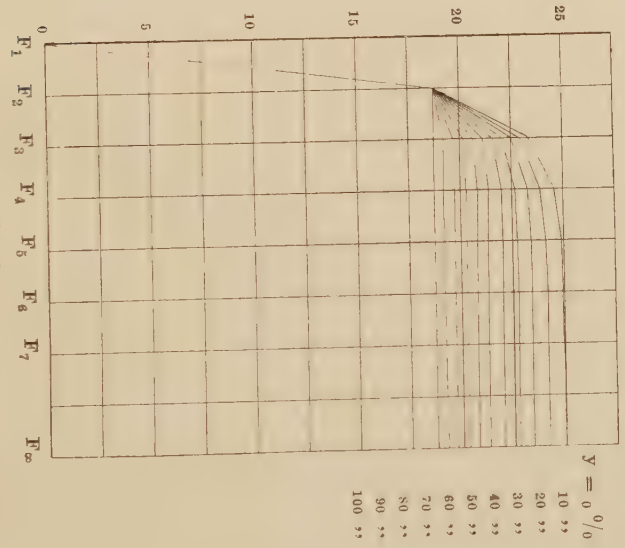


Fig. 9.

Kurven der theoretischen Verschiebung der einfachdominanten Ab-und aB-Typen nach dihybrider Bastardierung mit y = 0 % usw. Fremdbestäubungen ohne Selektion.

In Beziehung zu solcher Verschiebung einer Diheterozygote sind zwei Versuchsreihen ausgeführt worden, u.zw. die Bastardierung einer gelbglatten mit einer grünrunzeligen Erbse sowie

diejenige einer blaurunzeligen mit einer weissglatten Mayspflanze. Die Mischung der Samen, sowie die ganze Methode war dieselbe wie in den Versuchen mit Monoheterozygoten ohne etwaige Selektion. Die Zahlenergebnisse können wie folgt tabellarisch zusammengestellt werden:

TABELLE XV. ERBSEN. GELBGLATT × GRÜNRUNZELIG, OHNE SELEKTION.

	AB. Ge.gl.	Ab. Ge.r.	aB. Gr.gl.	ab. Gr.r.	%AB	%Ab	%aB	%ab
F_1 (1914)	17	0	0	0	100.0	0.0	0.0	0.0
F_2 (1915)	329	103	109	32	57.42	17.98	19.02	5.58
F_3 (1916)	1197	682	714	407	39.90	22.73	23.80	13.57
F_4 (1917)	980	703	759	558	32.67	23.43	25.30	18.60
F_5 (1918)	867	729	758	646	28.90	24.30	25.27	21.53
F_6 (1919)	811	736	761	692	27.03	24.53	25.37	23.07
F_7 (1920)	788	741	753	719	26.27	24.70	25.10	23.97

TABELLE XVI. MAYS. BLAURUNZELIG × WEISSGLATT, OHNE SELEKTION.

	AB. Bl.gl.	Ab. Bl.r.	aB. W.gl.	ab. W.r.	%AB	%Ab	%aB	%ab
F_1 (1917)	19	0	0	0	100.0	0.0	0.0	0.0
F_2 (1918)	3283	1061	1121	349	56.47	18.25	19.28	6.00
F_3 (1919)	5703	1812	1907	578	57.03	18.12	19.07	5.78
F_4 (1920)	5686	1822	1903	589	56.86	18.22	19.03	5.89
F_5 (1921)	5707	1801	1927	565	57.07	18.01	19.27	5.65
F_6 (1922)	5660	1841	1898	601	56.60	18.41	18.98	6.01

Vergleicht man diese Ergebnisse mit dem für Erbsen nach dem y = 0 % - Schema erwarteten Verlauf, sowie mit dem für Mays als panmiktische Pflanzenart gültigen Schema, so wird sofort klar, dass im grossen Ganzen die Versuchszahlen mit den theoretischen in ziemlich gutem Einklang stehen. In einer Hinsicht jedoch kann auch hier eine Abweichung von der mathematischen Grundlage konstatiert werden: die Typen mit glatten Samen sind wie in den Erbsen, auch in den Maysversuchen in zu grosser Frequenz vorhanden. Die AB-Typen und die aB-Gruppen, welche also beide glatte Samen haben, überschreiten fortwährend die Erwartung, während demgegenüber die runzeligen Pflanzen (Ab- und ab- Klasse) in geringeren Zahlen ausgemendelt

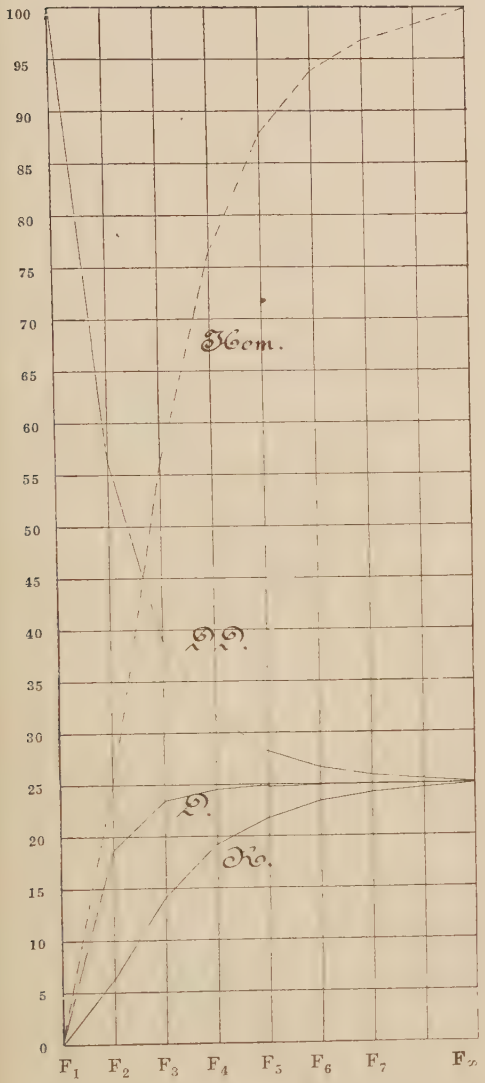


Fig. 10. 1.

Kurven der theoretischen Verschiebung des doppeldominanten (DD)-Typus, der einfachdominanten (D-)Typen, sowie des rezessiven (R-)Typus nach dihybrider Bastardierung mit y = 0 % Fremdbestäubungen (absolute Autogamie) ohne Selektion. Die gestrichelte Linie (Hom.) stellt die Gesamtzahl der Homozygoten dar.

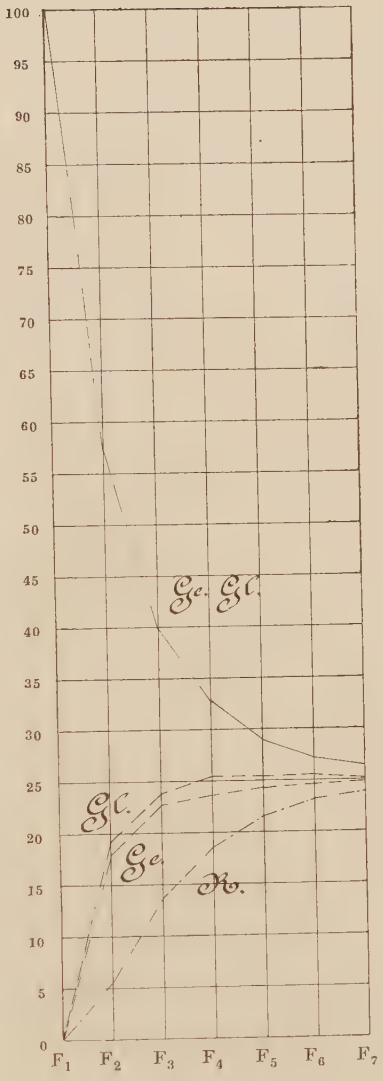


Fig. 10. 2.

Kurven der experimentellen Verschiebung der gelbglatten (GeGl.), der grünglatten (Gl.), der gelbrunzeligen (Ge) und der grünrunzeligen (R) Nachkommen einer dihybriden Erbsenbastardierung ohne Selektion.

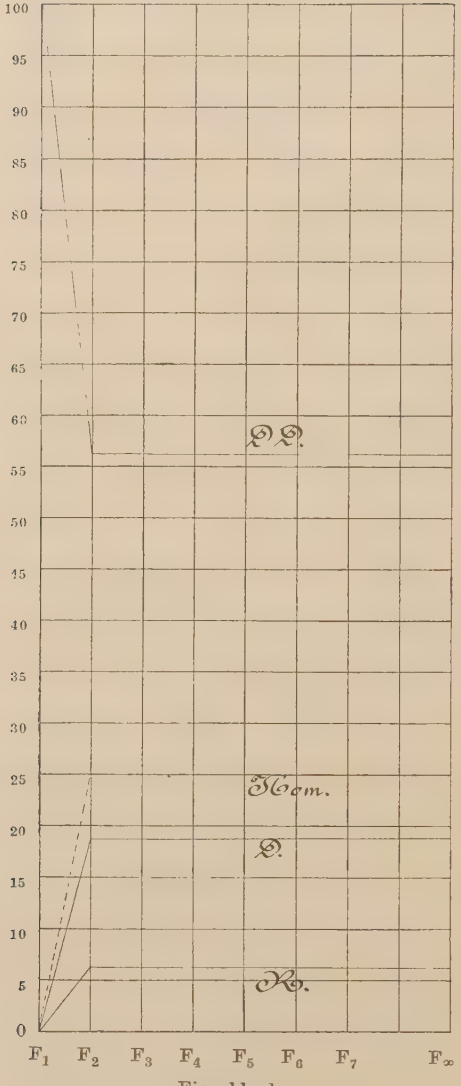


Fig. 11. 1.

Kurven der theoretischen Verschiebung des doppeldominanten (DD-)Typus, der einfachdominanten (D-)Typen sowie des rezessiven (R-)Typus nach dihybrider Bastardierung mit y = 100 % Fremdbestäubungen (völlige Panmixie) ohne Selektion. Die gestrichelte Linie, welche bei 25 weiter horizontal verläuft (Hom.) stellt die Gesamtzahl der Homozygoten dar.

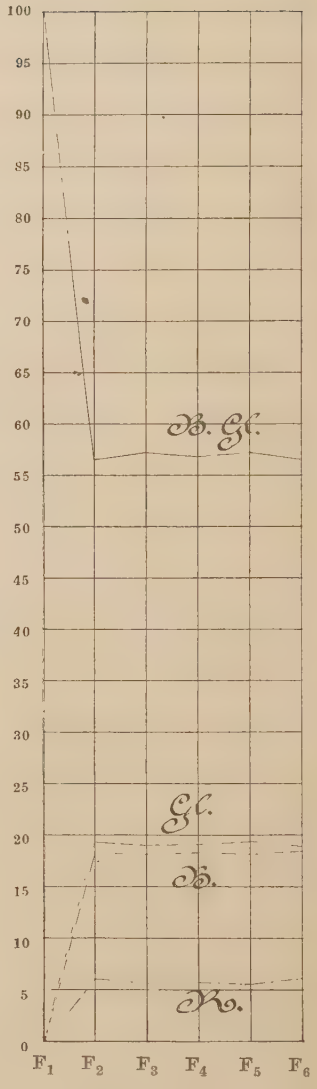


Fig. 11. 2.

Kurven der experimentellen Verschiebung der blauglatten (B. Gl.), der gelbglatten (Gl.), der blaurunzeligen (B) und der gelbrunzeligen (R) Nachkommen einer dihybriden Maysbastardierung ohne Selektion.

sind. Vielleicht ist hier also wieder ein Unterschied in Wachstumsgeschwindigkeit dafür die Ursache; die graphischen Darstellungen in den Figuren 10 und 11 zeigen die Ueberlegenheit der glatten Typen sehr deutlich. In Figur 10 sind die mathematischen Kurven des Doppeldominanten (AB), der Einfachdominanten (Ab - oder aB - Typus) und der Rezessiven (ab- Individuen) bei voller Autogamie, sowie die experimentellen *Pisum*-Kurven für Gelbglatt (Ge Gl), Gelbrunzelig (Ge), Grünglatt (Gl) und Grünrunzelig (R) abgebildet. Die Gl-Linie zeigt also fortwährend einen höheren Verlauf als die Ge-Linie. Und Fig. 11, welche die verschiedenen Linien bei absoluter Panmixie, sowie die experimentellen Mays-Kurven wiedergibt, lässt ebenso die Unterschiede der beiden „Glatt" Linien den Runzeligen gegenüber deutlich an den Tag kommen.

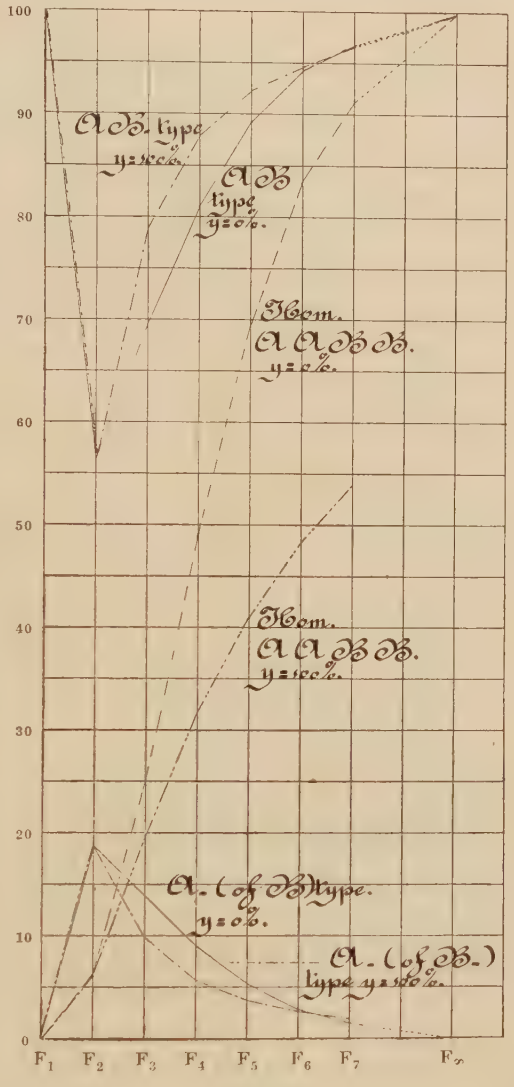


Fig. 12.

Kurven der theoretischen Verschiebung des doppeldominanten (AB-)Typus, und der einfachdominanten (Ab-oder aB-)Typen nach dihybrider Bastardierung mit y = 0 % und y = 100 % Fremdbestäubungen unter fortwährender Selektion der doppeldominanten(AB-)Typen. Die — — — Linie (Hom. AABB) stellt die Zahl der Homozygoten AABB dar bei 0 %, die —.—.—.— Linie diejenige bei 100 % Fremdbestäubungen dar.

* * *

d. Dihybride Bastardierung und ihre Nachkommen mit andauernder Auswahl der dop-

peldominanten, also AB-Pflanzen, während sämtliche ausspaltende Ab-,aB-und ab-Individuen beseitigt wurden.

Die hier in Frage kommende Verschiebung einer dihybriden Population aus welcher nur die AB-Individuen zur Fortpflanzung ausgewählt werden, ist m.W. noch nicht mathematisch bearbeitet worden. Ich habe nicht versucht eine allgemeingültige Formel des Verlaufs einer verschieden zusammengesetzten Ausgangspopulation abzuleiten, sondern nur die für unsern Spezialfall einer Dihybride mit normaler Spaltung und nachheriger Selektion gültigen Formeln herauszufinden mich bemüht. Die Verschiebung unter völliger Autogamie und diejenige unter stetiger Panmixie sind in den Tabellen XVII bzw. XVIII (S. 35 bzw. 36) dargestellt; ihre graphische Wiedergabe findet sich in Figur 12.

Als allgemeine Formeln gelten also für diesen Verlauf:

	AB-Typus	Ab-oderaB-Typus	ab-Typus
bei voller Autogamie ($y = 0\ ^0/_0$):	$(2^{n-1}+1)^2$	$2^{n-1}+1$	1
bei voller Panmixie ($y = 100\ ^0/_0$):	$(n^2-1)^2$	n^2-1	1

Versuche über eine derartige Populationsänderung unter Mitwirkung der Selektion, wobei nur AB-Typen zur Fortpflanzung ausgewählt wurden, sind auch hier nur mit Erbsen und mit Mays-Bastardierungen vorgenommen worden, u.zw. mit den Hybriden: Gelbglatten Erbsen („Stam Krombek") × grünrunzeligen („Wonder van Amerika"), sowie mit Blaurunzeligem Mays × weissglattem. Die aus diesen Versuchen hervorgegangenen Zahlen haben im allgemeinen wieder eine schöne Bestätigung der auf mathematischem Grunde gebauten Erwartungen ergeben; ihre Zusammenstellung findet sich in den nachstehenden Tabellen XIX und XX; ihre graphische Darstellung in Figur 13.

TABELLE XVII. DIHYBRIDE MIT AUTOGAMIE (Y = 0 %) UND SELEKTION DES AB-TYPUS.

	OHNE DOMINANZ									VÖLLIGE DOMINANZ				%				
Formel	I AaBb	II AaBB	III Aabb	IV AABb	V aaBb	VI AABB	VII AAbb	VIII aaBB	IX aabb	I, II, IV, VI AB	III, VII Ab	V, VIII aB	IX ab	Hom. des AB-Typus	% AB-Typus	% Ab-Typus	% aB-Typus	% ab-Typus
F_1	alle									alle				0.0	100.0	0.0	0.0	0.0
F_2	4	2	2	2	2	1	1	1	1	9	3	3	1	6.25	56.25	18.75	18.75	6.25
F_3	4	6	2	6	2	9	3	3	1	25	5	5	1	25.0	69.44	13.89	13.89	2.78
F_4	4	14	2	14	2	49	7	7	1	81	9	9	1	49.0	81.00	9.00	9.00	1.00
F_5	4	30	2	30	2	225	15	15	1	289	17	17	1	69.44	89.21	5.25	5.25	0.31
F_6	4	62	2	62	2	961	31	31	1	1089	33	33	1	83.13	94.21	2.85	2.85	0.09
F_7	4	126	2	126	2	3969	63	63	1	4225	65	65	1	91.11	97.00	1.49	1.49	0.02
F_∞						alle				alle				100.0	100.0	0.0	0.0	0.0
F_n	2^2	2^n-2	2	2^n-2	2	$(2^{n-1}-1)^2$	2^n-1-1	$2^{n-1}-1$	1	$(2^{n-1}+1)^2$	$2^{n-1}+1$	$2^{n-1}+1$	1					
	$(2^{n-1}+2)^2$									$(2^{n-1}+2)^2$								

TABELLE XVIII. DIHYBRIDE MIT PANMIXIE (Y = 100 %) UND SELEKTION DES AB-TYPUS.

Formel	OHNE DOMINANZ									VÖLLIGE DOMINANZ				% Hom. des AB-Typus	% AB-Typus	% Ab-Typus	% aB-Typus	% ab-Typus
	I AaBb	II AaBB	III Aabb	IV AABb	V aaBb	VI AABB	VII AAbb	VIII aaBB	IX aabb	I, II, IV, VI AB	III, VII Ab	V, VIII aB	IX ab					
F_1	alle									alle				0.0	100.0	0.0	0.0	0.0
F_2	4	2	2	2	2	1	1	1	1	9	3	3	1	6.25	56.25	18.75	18.75	6.25
F_3	16	16	4	16	4	16	4	4	1	64	8	8	1	19.75	79.00	9.99	9.99	1.02
F_4	36	54	6	54	6	81	9	9	1	225	15	15	1	31.64	87.89	5.86	5.86	0.39
F_5	64	128	8	128	8	256	16	16	1	576	24	24	1	40.09	92.16	3.84	3.84	0.16
F_6	100	250	10	250	10	625	25	25	1	1225	35	35	1	48.23	94.52	2.70	2.70	0.08
F_7	144	432	12	432	12	1296	36	36	1	2304	48	48	1	53.89	95.96	2.00	2.00	0.04
$F\infty$						alle			0	alle	0	0	0	100.0	100.0	0.0	0.0	0.0
F_n	$4(n-1)^2$	$2(n-1)^3$	$2(n-1)$	$2(n-1)^3$	$2(n-1)$	$(n-1)^4$	$(n-1)^2$	$(n-1)^2$	1	$(n^2-1)^2$	n^2-1	n^2-1	1					
	n^4									n^4								

TABELLE XIX. ERBSEN. GELBGLATT × GRÜNRUNZELIG MIT SELEKTION DER GELBGLATTEN (AB-TYPUS).

	AB. Ge.gl.	Ab. Ge.r.	aB. Gr.gl.	ab. Gr.r.	%AB	%Ab	%aB	%ab
F_1 (1914)	19	0	0	0	100.0	0.0	0.0	0.0
F_2 (1915)	302	85	103	29	58.19	16.38	19.84	5.59
F_3 (1916)	2095	402	439	64	69.83	13.40	14.64	2.13
F_4 (1917)	2452	260	265	23	81.73	8.67	8.83	0.77
F_5 (1918)	2704	120	169	7	90 .13	4.00	5.63	0.24
F_6 (1919)	2836	72	89	3	94.53	2.40	2.97	0.10
F_7 (1920)	2918	38	43	1	97.27	1.27	1.43	0.03

TABELLE XX. MAYS. BLAURUNZELIG × WEISSGLATT MIT SELEKTION DER BLAUGLATTEN (AB-TYPUS).

	AB. Bl.gl.	Ab. Bl.r.	aB. W.gl.	ab. W.r.	%AB	%Ab	%aB	%ab
F_1 (1917)	21	0	0	0	100.0	0.0	0.0	0.0
F_3 (1918)	3392	1121	1134	374	56.34	18.62	18.83	6.21
F_3 (1919)	7925	978	1000	97	79.25	9.78	10.0	0.97
F_4 (1920)	8807	562	596	35	88.07	5.62	5.96	0.35
F_5 (1921)	9252	343	393	12	92.52	3.43	3.93	0.12
F_6 (1922)	9493	228	274	5	94.93	2.28	2.74	0.05

Die auch in den vorigen Versuchen beobachtete Erhöhung der Klassenfrequenzen der glattsamigen Individuen ausgenommen, haben also auch diese Selektionsversuche eine schöne Bestätigung der mathematischen Berechnungen ergeben.

* * *

Zusammenfassung.

In obiger Arbeit sind mathematische Formeln zusammengestellt worden, welche die Verschiebungen in Populationen, welche monohybriden und dihybriden Kreuzungen ihre Entstehung verdanken und ohne jede Auswahl oder mit Selektion der Dominanten ((bzw. Doppeldominanten) Individuen sich vermehren, darstellen.

Dazu sind mit Erbsen, Bohnen, Ackerbohnen und Mays Kulturversuche vorgenommen worden, welche einerseits dienen sollten zur Kontrolle der Verwirklichung dieser mathematischen

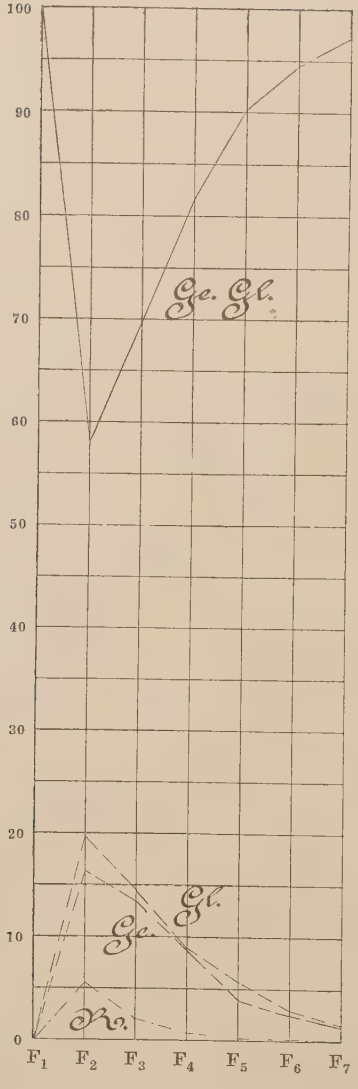


Fig. 13. 1.

Kurven der experimentellen Verschiebung der gelbglatten (Ge.Gl.), der grünglatten (Gl.), der gelbrunzeligen (Ge), sowie der grünrunzeligen (R) Nachkommen einer dihybriden Erbsenbastardierung unter fortwährender Selektion der gelbglatten Samen.

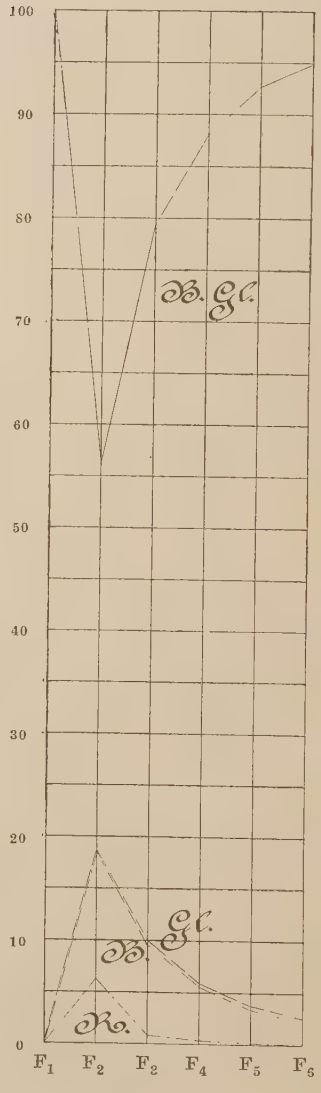


Fig. 13. 2.

Kurven der experimentellen Verschiebung der blauglatten (B.Gl.), der weissglatten (Gl.), der blaurunzeligen (B), sowie der weissrunzeligen (R) Nachkommen einer dihybriden Maysbastardierung unter fortwährender Selektion der blauglatten Samen.

Berechnungen in der Pflanzenzüchtung; andererseits zur Feststellung der Fremdbefruchtungsfrequenzen in diesen Pflanzenarten.

Die Versuche mit Erbsen gingen sämtlich daraufhin, dass sie die Erbse als eine sehr stark autogame Pflanze characterisieren; nur traten in allen Bastardierungen die glattsamigen Individuen in zu grosser Frequenz hervor, welche Abweichungen vielleicht einem Unterschiede in Wachstumsgeschwindigkeit der beiden Pollenarten zugerechnet werden sollen.

Die mit Bohnen angestellten Versuche haben die ziemlich starke Fremdbefruchtung dieser Pflanzenart (10 bis 20 %) erwiesen; eine Zahl welche höher ist als die in der bisherigen Litteratur angegebene.

Die Fremdbefruchtungsfrequenzen der Ackerbohnen haben sich als noch höher gezeigt; aus den erhaltenen Zahlen darf wohl auf eine Fremdbefruchtung von 30 bis 40 % geschlossen werden.

Mays hat sich schliesslich als eine völlig panmiktische Pflanze gezeigt; auch hier jedoch waren in allen Versuchsreihen die glatten Samen den runzeligen an Zahl überlegen.

Im übrigen haben die erhaltenen Versuchszahlen, welche auch in graphischen Darstellungen wiedergegeben sind, die mathematisch berechneten Verschiebungen vollauf bestätigen können.

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DIE VERSCHIEBUNG GENOTYPISCHER VERHÄLTNISZAHLEN INNERHALB POPULATIONEN LAUT MATHEMATISCHER BERECHNUNG UND EXPERIMENTELLER PRÜFUNG

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